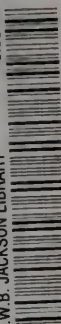


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An Experimental Study of Recognition and Recall in Abnormal Mental Cases

BY

MARGARET WYLIE

UNIVERSITY OF MICHIGAN

A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy in the
University of Michigan
1928

PUBLISHED FOR THE AMERICAN PSYCHOLOGICAL ASSOCIATION BY

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The writer wishes to express her sincere appreciation to Professor Walter B. Pillsbury under whose guidance the following problem was carried on. She also wishes to thank Professor John F. Shepard for his interest and Dr. Carl R. Brown for suggestions in regard to the mathematical treatment of data. To Doctor Albert M. Barrett of the State Psychopathic Hospital and Doctor E. A. Christian of the Pontiac State Hospital the writer's thanks are here expressed for their interest and their provision of excellent facilities for the experimental work. To the patients, students and others who served as subjects her hearty thanks are given.

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I. INTRODUCTION

With the decided interest manifested of late in the "new" psychology comes the increased necessity of taking into the laboratory for careful and thorough study phases of the mental life of abnormal patients. Just as a better understanding of the problems of the normal individual can come through the appreciation of the problems of abnormal mental life, so, much is to be gained in the study of the abnormal by the same methods that have been applied to the normal individuals, *i.e.*, intensive work with a subject over a long period under controlled conditions to determine his fairly characteristic behavior in the face of certain set tasks.

II. PREVIOUS WORK WITH ABNORMAL TYPES

A review of the experimental work done with abnormal patients as subjects brings to light the fact that this type of work had its origin in Germany and under the influence of Wundt. Emil Kraepelin, a physician, was much interested in the psychological aspects of psychiatric problems and began his first experimental studies at Dorpat in a laboratory that was part of the Physiological Institute. The problems at first were typical of the Wundtian laboratory, *i.e.*, simple reaction studies, and later were extended to the study of *Leistungsfähigkeit*, *Aufmerksamkeit*, *Auffassungsfähigkeit*, *Merkfähigkeit* and a study of the changes brought about in these abilities through sleep, drugs, fatigue and other factors. In the first article of the first volume of "Psychologischen Arbeiten," Kraepelin (16) outlines his work and methods. Another man who did much to promote experimental work with abnormal patients was Robert Sommer, psychiatrist in Giessen. He published in 1899 a "Lehrbuch der Psycho-pathologischen Untersuchungsmethoden." In a publication edited by him "Klinik für Psychiatrie und Nervöse Krankheiten" reports of various experimental studies are given.

Of the studies in *Auffassungsfähigkeit* Ludwig Cron collaborated with Kraepelin (6) to measure this ability of six subjects, three normal and three abnormal, a chronic alcoholic, an epileptic with dipsomania and a paranoiac. Various factors such as the influence of the number of repetitions and the length of interval between the exposure and the test were included in the study. They found that their subjects showed wide variations in their responses, especially in the speed of perception. They felt that in the case of the alcoholics the differences were diagnostic, typical of their state and served to throw more light on the personality reactions than the "Binet" tests.

Joseph Reis (26) used for his study of this ability fourteen abnormal and five normal cases. Of the abnormal eight were

dementia praecox of the hebephrenic type and six of dementia paralytica. The test consisted of the correct reading of one-syllabled words and nonsense syllables as a measure for the speed of taking in impressions. The normal ranked highest, the hebephrenic next and the paralytic lowest. In the dementia praecox cases this ability was not seriously encroached upon but frequently was covered up by a lack of interest and apathy. In the paralytic cases the difficulty of grasping showed itself in the inability of the patients to orient themselves. A steady, similar course of work was noted with the normal but with the paralytic, the work was dissimilar, jerky, conditioned by the ability of attention. The hebephrenic came between the two extremes. Practice progress was greatest for the normal and least for the paralytics.

Adolph Gross (8) among his studies made an intensive one of three epileptic cases using simple and choice reaction. He concluded that the disturbance of attention in the simple reaction was not shown in the choice reaction due to "Auffassung." The disturbance of the Auffassung showed itself in an increased difficulty of perception wherein the material seemed relationless, contentless, requiring a special enlistment of the attention for its grasp. The other disturbance was that of the release of will in some cases showing an inhibition and in others a facilitation of action.

For the study of *Merkfähigkeit* of both normal and abnormal groups T. Bogdanoff (3) used fifty-five normal and one hundred fifty-three abnormal subjects. Of this latter group forty-eight were paralysis progressiva; fifty-two, dementia praecox; twenty, epilepsy; twelve, chronic alcoholism; twenty-one miscellaneous, of which seven were of the manic-depressive group, five in the manic state and two in the depressed phase. As material he used nine geometrical figures simultaneously exposed for thirty seconds. Immediately afterwards by the recognition method the subject selected those he had seen from a group containing the nine of the observation mixed with sixteen others. By taking the mean number of the successes of each group Bogdanoff ranked the groups as follows: the normals were most successful

with a mean of 7.6, next came the chronic alcoholics and manic states with 7.0 each, the dementia praecox scored 6.0, the epileptic 5.9 and the paralytic group last with 5.4. He also ranked them according to least false answers. Here the normal ranked first 0.8, then came the chronic alcoholics 1.6; epileptics 1.7, manic state 2.0; dementia praecox 2.1, with the paralytics scoring 4.2.

Herman Schneider (27) investigated in the psychiatric clinic at Heidelberg in 1898-1899 the *Auffassung-und Merkfähigkeit* of five senile cases. Using simple objects and pictures after intervals of from five to sixty seconds the subjects reported what had been shown. All seniles showed a very marked disturbance of *Merkfähigkeit* for new impressions. He tried the same tests on two sixty-year-old paralytic cases, found that the simple objects and pictures were remembered for hours and could be enumerated in part and concluded that the tests were not fine enough to get at the memory disturbance of the paralytic case.

Paul Ranschburg (24) of Budapest maintains the diagnostic value of memory measurements, reaction time and amount reproduced. He also (25) investigated the *Merkfähigkeit* of normal, neurotic and psychotic individuals.

In addition to the studies dealing with phases of perception there were others centered about phases of the learning problem. C. G. Jung (12, 13) employed association tests. These not only proved of great interest but have had a wide application both in educational and clinical procedure. Kent and Rosanoff (15) also carried on extensive studies of association and accounted the tests of diagnostic value. Kent (14) studied habit formation while Boring (4) studied learning in dementia praecox cases. Kent found that practice effects could be obtained while Boring demonstrated that the patients could be trained but they showed great individual differences in the ability to learn, in the manner of procedure, and in the consciousness accompanying the performance.

Of the studies based on aspects of the memory problem Barnes (2) tested seven abnormal individuals using the *treffer*-method with nonsense material. She found that lengthening a series required a greater number of repetitions for the insane than for the normal individual; generative, effectual and retro-

active inhibition were much more pronounced in their effect in the abnormal than in the normal; much greater advantage was seen in the use of divided as over against accumulated repetitions for the insane than for the sane; all sources of confusion and error worked more markedly for the pathological mind than for the healthy; in fact, all factors investigated were operative but with much greater force in the insane.

Brodman (5) studied two Korsakow cases. He found that with series of eight and twelve syllables even given a hundred repetitions the patients were unsuccessful. Any lengthening of the series increased the difficulty very decidedly. Of the responses given as high as twenty-five per cent were false memory.

Liljencrants (17) studied four cases of mental deterioration, a Korsakow case, a senile dementia, cerebrosyphilis case and cerebral arteriosclerosis. He used two types of material: pictures of objects and irregular figures. He combined recall and recognition tests. He tested recognition by the selection method and gave opportunity for free recall just prior to the recognition test. He concluded that memory defect varied with the different subjects and was "due both to faulty apprehension and to faulty retention." It affected both recognition and recall and was evident with both types of material though more for the figures than the pictures. The defective subjects showed the same effects as normal subjects in apprehension and memory. They also showed the beneficial effects of primacy, recency and repetition.

W. G. Smith (29) gave among other tests one in recognition and immediate memory to ten abnormal subjects, epileptics with seizures of the grand mal type. Five of these with an average age of thirty-five years were fairly clear and rational between their seizures and were designated the first epileptic group. The other five with an average age of thirty-eight years showed at all times marked dementia and were designated the second epileptic group. He checked these groups with six normal subjects, with an average age of twenty-six years. They were assistants on the hospital wards. For the recognition test he used two types of material: pictures and words. He showed the subject seven small pictures allowing him as long as he wished to study

them. Then he asked the subjects to read aloud seven words. After an hour's time he presented the seven pictures with as many new ones and asked the patient to select the ones he had seen before. The same method was used with the words. Immediate memory was tested by having the subject repeat letters that were read to him as soon as the examiner finished reading the list. The errors of recognition were divided into two types: those of forgetting where an old picture or word was called new and those of confusion where a new one was called old. A preponderance of forgetting over confusion errors was found in the normal and first epileptic group but the opposite was the case with the second epileptic group, where the confusion errors led. The words gave much greater difficulty than the pictures. On the immediate memory Smith again observed a distinction between the normal and the first epileptic on the one hand and the second epileptic on the other in regard to the number of errors of insertion made. This type of error consisted of adding extraneous material that was not in the original list. The deteriorated group added letters not in the original list more than twice as often as the other groups. This type of error he regarded as similar to the confusion error of the recognition tests.

Moore (20) investigated the problem: how far and to what extent do disturbances of memory go hand in hand with decreasing ability to perceive? He used three types of mental cases involving diffuse cortical degeneration: dementia paralytica, dementia senilis and chronic alcoholism. His normal group was selected from laborers of the same social status and age as the patients. As material; real objects, pictures of objects, and printed and spoken words were used. At one test eight things were exposed without the aid of apparatus at the rate of two seconds each. The series was given once and the subject was asked to reproduce without regard to order as many things as he could remember. Then one minute after the conclusion of the test he was again asked to recall as many as he could. Moore concluded that immediate memory and the power of retention and of perception have a tendency to deteriorate together.

Hart and Spearman (9) included among other tests given to

sixty-one abnormal cases three for memory to test for "fullness of memory" (number of right answers) and for "fidelity of memory" (proportion of answers not right but given wrong instead of forgotten). They used the method of paired associates with meaningful material. They concluded from the results obtained that their theory of a general factor and of specific factors in intelligence held true for abnormal types.

Of work with abnormal types employing current standardized tests two kinds may be illustrated, (1) that of Tendler (30) who used tests to differentiate between sub-groups of psychoneurotics and (2) that of J. C. Foster (7) who analyzed individual responses for diagnostic significance.

Tendler studied seventy cases of psychoneurotics including psychasthenics, neurasthenics and hysterics. The results were checked with the results of normal individuals. The median mental age for the psychoneurotic was 12.0 years while that of the normal was 14.3. He also differentiated the sub-groups by median mental age as follows: neurasthenic 10.7 years; psychasthenic 12 years, and hysteric 13.6 years.

Foster analyzed the responses made by abnormal patients on memory tests of the Terman Revision of the Binet series. Nothing striking or significant was shown in the memory span for digits or sentences. There were, however, significant responses with the drawings and the memory of short paragraphs. In general in regard to the shape of drawings the deteriorated alcoholics, feeble-minded, arteriosclerotic and senile dementia cases showed a sketchy drawing while the syphilitic psychoses, dementia praecox and paranoid conditions showed an elaborated drawing. In regard to size, the feeble-minded, manic-depressive and alcoholic showed diminished size while the syphilitic psychoses, dementia praecox and paranoid showed increased size of drawings. The score of the memory drawing advanced with increasing mental age but after the age of forty there was a dropping off with advancing chronological age. With the memory of short paragraphs the average fell off with advancing chronological age. Number of details increased with increasing mental age. Numbers of errors decreased slightly with advancing mental

age and did not change with chronological age. The non-insane were found superior to the insane of the same mental age, *i.e.*, the memory deteriorated or showed irregularities more quickly than intelligence at large. The feeble-minded were superior to the insane of the same mental age. Errors were least frequent among the non-insane and most frequent among the dementia praecox and general paresis cases. In regard to the addition of material not in the original selection the feeble-minded did not make additions; the non-insane made a few of close connection with the original material. Of the abnormal cases 70 per cent of the general paretics, 27 per cent of the manic depressives, 16 per cent of the alcoholic dementia cases and 4 per cent of the dementia praecox gave irrelevant material.

Wells and Martin (31) worked out a form of memory examination to be used with psychotic cases where an array of twenty-six items including old associations, current information, learning of new associations and recognition memory was presented. On the basis of one hundred and eleven records they found a median score of 87 per cent with a range of 25 per cent to 120 per cent and a correlation between memory quotient and the standard intelligence quotient of 81. They concluded that "no separation of psychotic groups serviceable for diagnostic purposes" was possible. Some of the average percentile scores secured are of interest: senile, 53 per cent; general paralysis, 68 per cent; manic depressive, depressed phase, 74 per cent; schizophrenia, 82 per cent.

The previous experimental work with abnormal cases brings out the following: *Auffassungsfähigkeit*, *Merkfähigkeit* and other phases of perception are important because they stress the significance of the ability and speed of perception and the rôle of attention and attitude as factors in observational memory. In perception as well as in learning, association and memory, great individual differences were found but these were not sufficiently distinctive or characteristic of the various groups to have diagnostic significance. In fact, little of diagnostic value has been found. Tests of association and memory (reproduction of ideas and drawings) were most suggestive.

III. EXPERIMENTAL WORK ON THE RELATION OF RECALL AND RECOGNITION

The experiments that have special significance for our problem are those dealing with the relationship between recognition and recall. Five of them will be briefly reviewed here. Only one of the five employed abnormal types. In this case the study of the abnormals was incidental.

MacDougall (19) used sense material with two types of presentation, visual and auditory, with two normal adult subjects. Series of ten words were recalled and then recognized from as many new ones after an interval of twenty minutes. The visual presentation gave higher scores for both recognition and recall. This may have been due to the fact that the visual presentation was a simultaneous exposure of all ten words while the auditory presentation was successive. Thus the two were not really comparable. The recognition success was always higher than recall success. The average scores were as follows: visual presentation: recall 56.9 per cent, recognition 77 per cent; auditory presentation: recall 53.5 per cent, recognition 74.5 per cent.

Myers (23) using a list of twenty words tested out the relationship between recognition and recall. His subjects were school children, 333 boys and 355 girls. The children were not informed of the nature of the test but thought that the original presentation was merely a spelling test. He drew the following conclusions: recognition is about two and one-half that of recall. There were great individual differences for both recall and recognition; the correlation between recall and recognition was surprisingly low; there was a general increase of incorrect answers and a decrease of correct ones with the increase of the time interval; many of the incorrect words showed a high degree of association in form and meaning with the stimulus words; the order of frequency for each word in recognition and recall was found to be about the same for the first words of the series but

there was a wide variation for those least frequently recalled; the affective element was very much more pronounced in recognition than in recall.

Heine (10) in a study making use of nonsense material found that retroactive inhibition was present in recall but not in recognition either when the material was presented serially or when it was presented by the method of paired associates.

Hollingworth (11) noted characteristic differences between recall and recognition in some tests with five normal individuals. The test was a form of the opposite tests in which a list of fifty adjectives was given to be responded to with the opposite. This was repeated from sixty to seventy-five times but only one or two trials at a sitting. When the sixty to seventy-five repetitions were completed the subject who had not expected to be called on to remember the list was asked to give as many of the pairs as he could within a fifteen-minute interval. The number given at the end of a three-minute period was noted. Then the material was tried out with as many new adjectives as a recognition test. Half of all that were recalled were given in the first three minutes. In the fifteen minutes 59.6 per cent was recalled. In three minutes or less 99.2 per cent was recognized. Conclusions: purpose and intention were much more effective in recall than in recognition; the value of a single presentation was greater for recognition than recall; the more meaningful material has the greater difference in the ratio of recognition to recall—words 2.2, picture 1.9, forms 1.4, syllables 1.2. Recognition was based on varying degrees of assurance which gave a fairly definite index of the accuracy of the recognition; assurance and correctness were higher the farther the material was removed from nonsense material; primacy and recency influenced recognition much as they did recall. A recognition span was found. Results on twenty-five observers of fifteen advertisements showed a span for immediate recognition of .78; on twenty-five observers of twenty-five advertisements one of .76; on twenty observers of twenty-five geometrical forms .62. Various sorts of material showed characteristic differences in relative recognizability and in the effect of increased interval. The influence of increased

series length varied with the material and stood in inverse relation to the meaningful character of the material.

Mulhall (22) carried out tests on the equivalence of repetitions needed for recall and recognition. Her results gave a ratio for the average for recall to the average for recognition of pictures 3.2, forms 2.2, words 1.8, nonsense syllables 1.2. She concluded that the difference was greatest with material rich in association and became less the fewer the associations. She studied the effect of intention to remember. Determined recall differs from undetermined recall more than determined recognition from undetermined recognition; the difference between determined recall and determined recognition is less than between undetermined recall and undetermined recognition; the influence of a determining factor is greater for recall of material rich in associations than for material void of them; primacy and recency both influence recall memory; the influence of each on recognition is less than on recall but greater for material devoid of association and less for material rich with association. In further work Achilles (1) used patients suffering with Korsakow disease, general paralysis, brain syphilis and arteriosclerosis. She used four types of material: words, forms, proverbs and nonsense syllables for the study of recognition and recall and a series of pictures for recognition only. Her results indicated that the relation between recall and recognition varies greatly with the different subjects, and with different materials for the same subject. All the mental cases studied showed, according to her findings, a memory defect present both in recall and recognition. The scores among the Korsakows were lower than those among the general paralysis and arteriosclerosis cases. She concluded finally that there was no striking difference in the way the diseases affected recall and recognition.

All of these experimenters then agree that there are noticeable differences between recall and recognition. The following can be especially noted. The correlation between recognition and recall is low. The recognition efficiency is much higher than the recall efficiency, particularly for meaningful material. Superiority of recognition increases with the increase of the time interval. In-

tention to remember helps recall more than recognition. Assurance is a fairly definite index of accuracy of recognition. Retroactive inhibition affects recall but not recognition. The number of repetitions needed for recall is greater than for recognition but is decidedly influenced by the type of material, the more meaningful showing the greatest difference, the least meaningful, *i.e.*, nonsense material, showing the least.

IV. THE EXPERIMENTS

A. STATEMENT OF THE PROBLEM

Work with normal subjects on the problem of recognition leads to the application of similar methods and tests on some abnormal types with special regard to the relationship between recognition and recall. Suggestions for the following were sought. What relationship is shown between recognition and recall, especially with non-meaningful material in (a) normal subjects, (b) non-deteriorated mental cases, (c) much deteriorated mental cases? Does recall disappear entirely while recognition remains? Does recognition disappear but recall remain? Do both remain but in varying degrees of utility? Do both disappear but at different rates? What distinguishing characteristics of this relationship, if any, can be seen in the various types of cases?

In addition in the problem of recall a qualitative study of types of responses was made to determine if outstanding differences between types could be found. The aim throughout has been to get many results on a few cases rather than few results on many cases as it was believed that by this means more characteristic responses could be obtained and more valuable and usable data secured.

The Experiments

The experiments fall into two groups: those for the non-deteriorated and those for the deteriorated type of case. With both groups three kinds of problems were presented: a learning problem, a problem in recognition and one in recall. In those of recognition and recall there was one series of meaningful material, pictures, one partially meaningful series, Chinese symbols with English equivalents, and several series of nonsense material, Chinese symbols paired with their Romanized equivalents (the clue to the Chinese of the pronunciation of the symbol), Chinese

symbols paired with nonsense syllables and paired nonsense syllables. The learning problem consisted of the mastery of a series of nonsense syllables.

B. SUBJECTS USED

Before presenting the types of cases the following frequently used terms need explanation. By abnormal is meant the individual who after a period of observation as a patient in a hospital for mental cases has been diagnosed psychopathic or psychotic. By normal is meant the individual who is maintaining himself satisfactorily outside an institution. Deteriorated type of case refers to those patients who in their behavior on the wards of the hospital show inferiority of memory, forgetfulness, lack of orientation. By non-deteriorated are indicated those who do not show this inferiority in their conduct on the wards. The abnormal cases were observed at two hospitals. The non-deteriorated cases were chiefly patients at the State Psychopathic Hospital in Ann Arbor. The deteriorated ones were inmates at the State Hospital in Pontiac, Michigan. The work was carried on from June, 1927, through March, 1928. Previous work on the problem of recognition with normal subjects had been done by the writer in the academic years 1917-1918 and 1923-1924. Results of five normal subjects tested in the latter period are included in this report.

In order to keep the group as homogeneous as possible it was limited to one sex, women. Usable results obtained from thirty patients and twenty normal subjects varied in amount from tests on each of four days to tests on four days a week for four months.

1. Normal subjects (twenty cases in all).

Five subjects tested in 1923-1924 gave data for the tests in recognition and recall after a twenty-minute interval. Of these one was a teacher in the local high school, one a Research Assistant in Psychology, one a graduate student in psychology and two college sophomores in the beginning course in psychology. All were intelligent and of more than average ability.

In the group tested in 1927-1928 fourteen of the fifteen were college sophomores in the beginning course in psychology and one a freshman in the same course. No memory defects were noted in any of these subjects.

It is obvious that a group of normal individuals who are not of the same age, social class and educational level as the abnormal group with which they are compared does not constitute an entirely satisfactory control. Moore (20) was one of the experimenters in this field who secured such a control. Because of the very great difficulties in obtaining such a group the college students were used. Nevertheless, it is not without an appreciation of its limitations as a control. The mathematical treatment of the data obviates the difficulty.

2 and 3. Abnormal subjects (thirty in all).

The diagnoses for these cases were secured from the hospital records. They were determined by the hospital staff in conference. Facts regarding hallucinations, delusions, orientation as well as information as to age, education and marital state were also obtained from the hospital records; the former from the psychiatrist's reports and the latter from the social histories.

2. Abnormal subjects: non-deteriorated cases, State Psychopathic Hospital (fourteen cases in all).

a. Manic-depressive cases (five in all).

A.St. Thirty-five years old, manic-depressive, manic state, psychoneurotic pains, admitted 5-6-27, duration prior to admission nine weeks, auditory hallucinations and delusions, clear, alert, intelligent, oriented in the three spheres, eighth grade education, married.

C.B. Thirty-one years old, hypomania with paranoid mental reactions, admitted 9-29-27, duration prior to admission three months, delusions, hallucinations, confusion, oriented in three spheres, easily distracted, talkative, restless, flight of ideas, euphoric, eighth grade education, married.

C.H. Thirty years old, manic-depressive, depressed phase with schizophrenic reactions, admitted 8-3-27, duration of psychosis prior to admission four months, auditory and visual hallucinations, delusions of persecution, ideas of reference, influence and personal sin, unclear, confused, lacks insight, oriented for place only, equivalent of eighth grade education in Hungary, came to America 14 years ago, no language difficulty, appeared absorbed with her own interests, talked to herself about things in her present situation, was frequently found by the examiner waiting outside ward door for her test, memory for facts in relation to herself was good, her great distractibility probably accounts for the low scores made on the tests, married.

P.A. Twenty-seven years old, manic-depressive, depressed phase, admitted 9-12-27, duration prior to admission one year, onset following scarlet fever which developed two days after confinement, auditory hallucinations, marked depression, delusions in regard to personal sin and somatic condition, anxiety about personal sin and obsessions concerning somatic condition, keen intelligence, oriented in all spheres, good memory, little interest, had to be fed, twelfth grade education, teacher prior to marriage.

A.D. Twenty-three years old, manic-depressive, depressed phase, admitted 5-20-27, duration five weeks prior to admission, depressed, confused, auditory hallucinations, resistive, refusal of food, forced feeding, fear of poverty, ideas of persecution, suicidal attempts, oriented in the three spheres, fair memory, married.

b. Schizophrenic cases (six in all).

D.F. Twenty-seven years old, schizophrenia with mild paranoid ideas, admitted 7-14-27, duration five months, confused, mild fears, ideas of persecution, not oriented, troublesome on the wards, childish in behavior, easily offended, sensitive, feeling of inferiority, suicidal attempts, fear of death, veronal habit, eleventh grade education, unmarried, telephone operator, held position for eight years prior to onset of present trouble.

U.B. Thirty-five years old, paranoiac condition, sensitive, delusions of interpretation, depressional features with a schizophrenic prognostication on account of heterosexual conflict and phantasy, admitted 5-24-27, duration prior to admission three years (later she was transferred from the State Psychopathic Hospital to the Pontiac State Hospital where the diagnosis agreed upon was schizophrenia), delusions, ideas of reference and influence and personal sin (sex life), suicidal thoughts, no hallucinations, oriented in the three spheres, clear, good memory, no apparent interests, indolent, seventh grade education, married.

W.M. Thirty years old, schizophrenia, paranoid type, subacute phase puerperal association, admitted 6-25-27, onset following childbirth 3-9-27, auditory hallucinations, delusions of mind control, electric shocks and poisoned food, suicidal attempts, confusion, spent much time kneeling in prayer, preceded her work on tests on three occasions by kneeling in prayer, ninth grade education, married.

J.P. Twenty-nine years old, schizophrenia, paranoid reactions, admitted 3-31-27, duration two years, ideas of persecution, intelligent, oriented in the three spheres, two years work in college, teacher, unmarried.

M.N. Twenty-nine years old, schizophrenia, hebephrenic type, chronic phase, admitted 1-27-27, duration prior to admission one month, oriented in the three spheres, clear, no hallucinations, twelfth grade education, nursemaid, unmarried.

J.K. Twenty-eight years old, schizophrenia, hebephrenic type, admitted 5-24-27, duration prior to admission two years, inaccessible, stood for long periods inactive or lay curled on couch, no interest in surroundings, tenth grade education, housework, unmarried.

c. Miscellaneous cases (three in all).

A.Sn. Forty-two years old, psychoneuroses, obsessional neurosis with anxiety and depressional features, admitted 7-12-27, duration prior to admission

"always queer," good memory, oriented, no hallucinations; the following frequently used expressions indicate the thought content: "I'm unutterably ugly," "I killed my mother," "wrecked my father's life," "everything is gone and utterly dark," "I'm just like an animal"; eighth grade education, music teacher, unmarried.

K.A1. Seventeen years old, psychopathic personality, admitted formerly 4-14-25 and released 5-27-25, readmitted 9-17-27, duration prior to first admission ten months, no hallucinations, no delusions, oriented in the three spheres, made normal scores on intelligence tests, no memory defect, clear, eighth grade education, housework, unmarried.

M.Ch. Seventeen years old, psychopathic personality, admitted first 1-2-25, released 3-4-25, readmitted 10-28-27, duration prior to first admission five months, no hallucinations nor delusions, oriented in the three spheres, no evidence of a memory defect, refused to coöperate after the fourth test as her curiosity about the test procedure had been satisfied and the tests then bored her, eighth grade education, housework, unmarried.

3. Abnormal subjects: deteriorated cases, Pontiac State Hospital (sixteen cases in all).

a. Senile cases (seven in all).

E.C. Seventy-three years old, senile deterioration with a presbyophrenic syndrome, admitted 7-21-27, duration of psychosis prior to admission three years, not oriented, cannot remember her place at table or her bed at night, spends time in walking, no evidence of any memory activity, no appreciation of defect, much deterioration, common school education, housewife, married.

S.C. Eighty-three years old, senile deterioration; confusion state, admitted 2-15-26, duration prior to admission two years, cannot care for physical needs, cannot remember her bed at night, cannot keep time straight, not oriented, often undresses in the middle of the day and refuses to undress at night, knows own name but names of objects gone though idea of use retained as shown by demonstrations, *e.g.*, key, no evidence of memory activity, much deterioration, appreciation of defect. "I don't believe I know anything." "I ain't no hand at all." "It's too bad I'm getting so I forget." "I don't know what's what." Common school education, housework, unmarried.

S.H. Eighty years old, senile deterioration, admitted 1-13-28, duration prior to admission not known, not oriented, some grasp of situations, appreciation of memory defect: "My head is in a whizzle." "My head is the weakest part of me." "Has been for years." "The only wonder is I remember anything." "There isn't a great deal I do remember." Common school education, seamstress, unmarried.

M.K. Eighty-seven years old, senile, admitted first as a case of paranoia, admitted 2-22-89, duration prior to admission eleven years, deteriorated but appreciated defect, fair grasp, after four tests refused to coöperate, further, calling the tests "dumb nonsense," could only remember one out of six words which annoyed her a great deal, said it was ridiculous to have to go to school at her time of life, had apparently been willing to work at first as she was curious and the tests occupied her; common school education, housewife, married.

M.McG. Seventy-seven years old, senile, admitted first as manic-depressive, depressed phase, admitted 7-6-16, duration prior to admission four years, oriented for place and persons but not for time, appreciated defect in her memory, "forgetful," "I forget but you're liable to forget at my age," common school education, saleswoman, married.

S.D. Seventy-eight years old, senile psychosis in a psychopathic personality, presbyophrenic syndrome, admitted 6-27-27, duration prior to admission unknown, not oriented, garrulous, appreciated defect but was ready with numerous excuses: "My trouble has shattered me." "I ain't a blockhead as a rule but this is hard for me." "My memory is cried away." No schooling, charwoman, unmarried.

A.O. Sixty-three years old, senile psychosis with cerebral arteriosclerosis, admitted 8-8-25, duration prior to admission seven years, not oriented, could not care for personal needs, confused, marked deterioration, common school education, housewife, married.

b. Pre-senile cases (three in all).

H.N. Fifty-eight years old, presenile with possible toxic state, admitted 12-27-27, duration prior to admission one year, not oriented, some evidence of memory, appreciation of defect, "I used to could remember anything and everything. Now I can't remember much." Eighth grade education, housewife, married.

A.McC. Fifty-three years old, presenile, history of dementia praecox, paranoid type, admitted 12-2-26, duration prior to admission eighteen years, oriented, memory fair, delusions, ideas of persecution, eighth grade education, housewife, married.

F.S. Fifty-nine years old, presenile, history of manic-depressive, depressed phase, admitted 12-31-26, duration prior to admission four years, memory fair, delusions, hallucinations, common school education, housewife, married.

c. General paralysis (four cases in all).

J.O. Forty years old, general paralysis of the insane, admitted 4-30-27; duration prior to admission not known, memory defect noticeable, eighth grade education, housework, unmarried.

A.C. (colored). Forty-two years old, general paralysis of the insane, episode of religious exaltation, admitted 8-25-27, duration prior to admission two years, some evidence of memory defect, delusions, fourth grade education, housewife, married.

A.P. Forty-five years old, general paralysis of the insane, admitted 2-15-26, duration prior to admission one year, memory defect noticeable, no hallucinations nor delusions, tenth grade education, housewife, married.

V.M. Thirty-five years old, general paralysis of the insane, admitted 10-11-26, duration prior to admission four years, at private sanatorium 8-4-23 to 10-1-23, at State Psychopathic Hospital 10-8-23 to 1-1-24, memory defect noticeable, no hallucinations nor delusions, ninth grade education, housewife, married.

These four cases had been inoculated for malaria. The malaria had run its course. The treatment had been completed some months before the patients were used as subjects. The deterioration in each case was believed by the medical men in charge of the cases to have been arrested by this treatment.

d. Miscellaneous cases (two in all).

M.H. Seventy years old, Korsakow case, admitted 6-1-11, duration prior to admission six months, much evidence of a memory defect which she appreciated, common school education, housewife, married.

A.Z. Twenty-five years old, postencephalitic psychosis, at time of first admission diagnosed as general paralysis of the insane, admitted first 10-25-24, discharged 4-24-25, readmitted 8-8-27, duration of psychosis prior to first admission two years. There was a history of syphilis in this case, together with a diagnosis of general paralysis of the insane. It was because of this latter that the case was included in the study. Further clinical evidence, however, removed the patient from this group. The results on the four tests given her are nevertheless included in this study. There was no evidence of a memory defect. On the ward her irritability, lack of control and troublesomeness frequently were very annoying. She spent most of her time on the disturbed ward. She completed eighth grade, did housework, was unmarried.

C. MATERIAL USED: THE TESTS

As stated earlier there were three problems of memory presented, learning, recall and recognition. Two kinds of material were used, meaningful and non-meaningful or nonsense material.

1. *Meaningful Material*

The meaningful material consisted of a series of pictures. Pictures are rated as of high mnemonic value by Moore (21). In a study of four individuals he finds the following percentages according to the material used: object 97 per cent, pictures 96 per cent, written word 90 per cent, spoken word 87 per cent. He tried this material with abnormal cases and concluded that the same order held for them and that which was weakest in the normal was first to deteriorate under pathological conditions. He quotes Pohlman's results to illustrate the difference in mnemonic value of materials presented in various ways.

The pictures were colored prints of great masters. Only one, No. 8, "A Dutch Interior," had ever been seen by any of the subjects and then only by three of the normal subjects.

Each picture represented a unity, one central figure or idea dominating and the other features fitting into this unity. The titles and dimensions, together with the details shown in the portions used in the tests, are given in the appendix. Eight pictures were used for study. Seven new ones similar in some way to seven of the old were shown with the old at the test period.

The series of tests with paired associates, where Chinese symbols and their English equivalents made up the pairs, were considered as partially meaningful material.

2. Non-meaningful Material

There were four kinds of nonsense material. Both this material and the method of its presentation do not have high mnemonic value. Achilles (1) found that recall and recognition efficiency are lowest with nonsense material and have a ratio of 1.2. A further factor reducing efficiency in some of the series was the time interval between presentation and test. Another factor making for lowered recall efficiency with the learning series was the use of the prompting method. Luh (18) found this the least favorable condition for retention on account of the number of restricting factors involved. It was used here as a means of knowing that the subjects were keeping to the task at hand at the time of showing. In addition retroactive inhibition may have entered to lower recall in the one hour and twenty-four hour test series because work was put in, though not of a similar nature, ten minutes after the study period, and, in the one hour interval continued up to ten minutes of the end of the hour interval. Similar hour and twenty-four hour tests without a work period between were not carried on so there is no check of the extent to which retroactive inhibition may have interfered.

Two forms of the nonsense material used for the problems of recall and recognition were similar, in that pairs of associates of which one member in each pair was a Chinese symbol made up a study series. With the non-deteriorated type fourteen pairs were used. The second members were Romanized syllables (the clue to the Chinese of the pronunciation of the symbols) or blanks. In twelve such series one had no blanks, six had three

blanks and five had four blanks. The blanks were put in incidentally as one of the means of testing for vivid imagery to see if, when a blank occurred, a vivid image or recall of some symbol accompanying a blank or of some other symbols or syllables of the series would come to mind with the force and frequency of Müller's *Aufhilfesilben*. In only one case, that of A.St., a manic, did anything of the sort happen. In this case, vivid images of symbols that went with blanks, syllables and extraneous material, featured. A few recalls of symbols that went with blanks were given by other subjects, but with all subjects, both normal and abnormal alike, blankness was reported as blankness. In addition some reported experiencing annoyance and frustration at the appearance of a blank because of their lack of success in recall. With the non-deteriorated type of case six pairs were added in the test period, there were further blanks among the second members of the added pairs.

With the deteriorated type of case but six pairs of associates were used in the study period and the second members of the pairs were nonsense syllables. No blanks were used. Six new pairs were added at the test period.

The third form of nonsense material was the use with the deteriorated cases of series of paired nonsense syllables. Six pairs made up the study series with six added for the test.

The fourth form was the use of single nonsense syllables presented serially as a learning problem.

With two of the non-deteriorated subjects, U.B. and A.Sn., series of Chinese symbols and Romanized equivalents were also used for learning by the prompting method.

The pairs were placed on slips of drawing paper three and one-half inches by three-fourths of an inch. The Chinese symbol was drawn in India ink with its center three-fourths of an inch from the left edge. It was one and one-half inches from the center of the syllable paired with it and midway between the upper and lower edges. The symbols were approximately three-eighths of an inch square. The letters of the Romanized and nonsense syllables were typed on with the exception of those of the six series of paired nonsense syllables used with the de-

teriorated cases where the letters were five-eighths of an inch and were printed by hand with India ink.

The single nonsense syllables were typed in the center of slips two and one-half inches by three-fourths of an inch in size.

3. Apparatus

A modified form of the Wirth memory apparatus built in the University of Michigan shops was used. Time of the responses was kept by means of a stop watch. Simplicity of apparatus and technique was sought. The nature and purpose of the apparatus was demonstrated to the subject at the time of the preliminary tests. At the State Psychopathic Hospital a three bed ward off the library was used. The patient was seated at a table with her back to the window. The exposure was at eye level except in tests with two normal subjects when it was below eye level. A one bed room on the receiving ward was used at Pontiac and here too the subject sat with a window at her back. In both cases the rooms faced the east. For the tests with the normals the same apparatus was used. A window was at the back of the patient and the room faced the east. The pictures were placed behind a cardboard screen and were clipped into place on the front of the memory apparatus screen. When the signal was given the cardboard screen was taken away and following the exposure was again placed in front of the picture and the picture removed.

D. PROCEDURE

Directions given the subjects for the various tests will be found in the appendix. The first test taken by any subject was used as a preliminary one to acquaint the subject with the nature of the experiment and accustom her to the test procedure. Apparatus was demonstrated and questions answered to help the subjects appreciate the nature of the tests and understand what they were to do. They were informed as to the purpose of each test except that with the pictures they were not told that they would be tested for recall and recognition after the series was

completed. When told in advance the subjects received the advantage to recall from purpose and intent to remember.

The subjects' responses were taken down as nearly verbatim as possible in an unobtrusive way and kept covered so that the subject was not troubled about the written record. The normal individuals were apparently more concerned about the written record than any other group, but after the first preliminary test seemed to pay no further attention to the experimenter's writing. The non-deteriorated cases were accustomed to having their responses recorded and did not show any curiosity about the procedure. Only three of the deteriorated cases, all seniles, asked about the record. One, who refused after the fourth sitting to continue further, made the comment at that time, looking toward the experimenter's writing materials as she did so: "If they have no evidence against you, they can't bring your case into court." The other two thought that the experimenter was sorry they could not remember all of the words and was therefore writing the list out for them.

*Procedure with the Test of Meaningful Material with Both
Deteriorated and Non-deteriorated Subjects*

For the study of the pictures the procedure was as follows: two were presented for observation and study at each of four sittings except with the deteriorated cases where one was presented at each sitting. Each picture was shown for thirty-five seconds, a time much used by Jaensch in testing out vividness of imagery. Four covers for the pictures were made, nine and three-fourths inches by nine and one-half inches, in each of which a square of two and five-eighths by two and three-fourths inches was cut at a different distance from the edge. Each cover was applied in several different positions to the fifteen pictures of the test. In the selection of the part of the picture to be exposed the central feature of the picture or the figure in Gestalt terms was not included but some other characteristic feature of the ground. In one case, that of the picture of the three polar bears, a stretch of the bluish-white snow was shown, but this section did not prove characteristic for the deteriorated cases. They

responded with: "There is nothing there"; "it's water"; "it's clouds." Whereupon the experimenter said, "No, it is snow," but this never gave a clue. Before the recognition test the subject was asked to name the picture she had studied. When the portion of the picture was exposed the subject was asked to tell whether the picture was new or old, to state if old her previous title (the one she had given it at the study period), to give her degree of certainty in terms of very sure, sure and not sure, both in regard to recall and in regard to correctness of the title. For the ones recalled she was asked to tell what made up the rest of the picture. She was next asked to sort the pictures into two piles, the ones studied and the new ones. When this was completed and the results noted, she was asked to arrange the old pile in the order in which the pictures had been shown her for study. The order was noted. Then she was given the new ones from which any old that she might have placed there in the previous test was excluded and she was told to match an old one with a new one similar to it in some way. The pictures that were regarded as similar and the reason for their selection was recorded.

Procedure with Tests for the Non-deteriorated Types

With one group of non-deteriorated cases the first series given was begun with the twenty minute interval test. For the twenty minute test, some subjects were given both a number of series where the Chinese symbol was paired with an English equivalent and a number where the Chinese was used with the Romanized equivalent. Some subjects had only the Chinese and English equivalent series while others had only the Chinese symbols with the Romanized equivalent.

In the twenty minute interval test, the procedure at any one sitting was as follows. Fourteen pairs of Chinese symbols with English equivalents in some series and Romanized equivalents in others were shown one by one by means of the memory apparatus at the rate of ten seconds per pair. However, in those cases in which the Chinese was followed by a blank the time of

exposure was five seconds. No blanks were used in the Chinese symbols and English equivalents series.

At the close of the exposure period, the subject was allowed to occupy herself in her usual manner during the twenty-minute interval. She was previously instructed not to think of the series in the interim. The normal subjects usually studied on lesson assignments or read during this period, while the abnormal sat about in much the same way as they did on the wards. At the end of the twenty minutes six new pairs were mixed with the old, but the subject was never told the proportion of new to old or the percentage of old included in the test. The order of test was a random one but was kept the same for each series and each subject. The first members of the pairs were shown first and the subject was asked to report whether she had seen the symbol before, and if so, to recall what went with it. She was asked whether she was very sure, sure, or not very sure of her responses, and she was requested to tell how she recognized the material. When the subjects neglected to make any such comments the experimenter asked at varying intervals, "How did you recognize it?" When they neglected to report an associate from time to time the question, "What went with it?" was included. These points of questioning are indicated on the individual's record by H and W respectively.

In one group of experiments where only the first members were shown this test involved the giving of twenty judgments. In the other series the second members were also tested immediately following the showing of the first. When both members were tested forty judgments were given at a test. If, in the testing of the second members, the subject recalled a symbol in whole or in part, she was asked to draw or describe it if possible. The time for each response was kept from the instant the exposure was made until the subject spoke. At the conclusion of the test the subject was asked to tell what she thought her success had been in terms of fair, good, poor, to compare the series with others shown as to difficulty, *i.e.*, harder than, easier than, or the same as the previous ones, and to state what method had

been used during the study period. The whole twenty-minute interval test required about fifty minutes.

In the hour interval test the procedure was as follows. A series of fourteen pairs of Chinese symbols and Romanized equivalents was shown at the rate of ten seconds per pair, with the exception of those Chinese symbols that went with blanks, where five seconds was the time of exposure. In the twelve series used for study six had three blanks, one had none, and five had four blanks. Then ten minutes later the subject was shown a picture for thirty-five seconds with the instruction to study it carefully, to be ready to give as many details as possible and suggest a suitable title. As soon as the picture was removed the answers were written out by the subject. This was then followed by a second picture with the same procedure. Then a series of fourteen single nonsense syllables was shown at the rate of five seconds each, first for study and then for anticipation of the next one in the series. The test was continued until each syllable had been anticipated though some of the successful reactions were but spontaneous corrections. The subject was then asked to write the list from memory. If, as happened in a few cases, the subject had not mastered this series within ten minutes of the end of the hour interval, the study was discontinued until the next sitting. No work was given during this next ten minutes. At the end of the hour the procedure was like that at the end of the twenty-minute period except that just prior to the recognition test the subject was asked to jot down any of the Chinese symbols or Romanized equivalents she remembered. During the fifth sitting, ten minutes after the exposure of the series for study, the test for the recognition and recall of pictures was made. During the sixth sitting of the one-hour series no new series to be remembered was learned but the five series previously shown were relearned. If the five series had not been relearned within the one-hour interval beginning ten minutes after the exposure and ending approximately ten minutes before the test began, the study was discontinued and renewed at the next sitting. This sitting usually took from one and a quarter to one and one-half hours.

With the twenty-four hour series the Chinese symbols and the Romanized equivalents used and the period allowed for their study were the same as indicated at the beginning of the hour interval test. After the subject rested for ten minutes a series of nonsense syllables was shown at the rate of five seconds per syllable, three times round. Then a ten-minute interval followed, after the first thirty seconds of which a picture was shown with directions similar to those given in the one-hour test. This procedure rarely took more than four minutes. At the end of this ten minutes the series was again shown, three times round. Then followed a second ten-minute interval, thirty seconds after the beginning of which a second picture was shown with the usual directions. The time of exposure with the picture was thirty-five seconds. Following the ten-minute interval the test for this sitting was concluded with three more repetitions. This sitting generally required forty-five minutes. Twenty-four hours later the procedure was as follows. First the subject was asked to recall any Chinese symbols or Romanized equivalents; then fourteen old pairs were mixed with six new pairs. The first members were shown first and following this the second members were tested in the same manner as in the other tests described above. Forty judgments were given at a test. At the end of the test period in each case the subject was asked the same questions as in the procedure for the twenty-minute test. Following this the series of nonsense syllables shown twenty-four hours earlier was shown by the prompting method. Moreover, the subject was given an opportunity to anticipate the first syllable. By the end of the seventh sitting the eight pictures had been shown. During the ninth sitting in the ten-minute intervals between repetitions of the nonsense material, the testing of the picture series was carried on and concluded if necessary at the end of the showing of the learning series. At the eleventh sitting, ten minutes after the exposure of the Chinese symbol and Romanized equivalent series for study, the five series of nonsense syllables were re-learned. At the twelfth sitting the last Chinese symbol and Romanized equivalent series was tested within the same routine as above.

Procedure with the Deteriorated Type of Case

With six series of six pairs in which a Chinese symbol was combined with a nonsense syllable printed in the usual type, the deteriorated cases were tested for immediate recall at the end of each repetition and for recognition at the end of the third repetition. At this point six new pairs were added. Following this the test was continued up to fifty trials as a learning test. Because of the continued neglect of the Chinese symbol the next six series of six pairs were made up of paired nonsense syllables. The letters were five-eighths of an inch in height to overcome certain visual difficulties of the senile patient. Six new pairs were put with these at the recognition test periods which occurred after the fifth and tenth repetitions while recall was tested at the close of the fifth, tenth and fifteenth repetitions.

E. RESULTS

Series 1, Picture Test

Fourteen normal subjects and twenty abnormal ones took part in this test. It was not possible to arrange the intervals between the study of each picture and the test so that they would be the same for each subject and therefore the results were not comparable. However, the times were approximately the same for any one group. The meaningful nature of the material was appreciated by the normal and non-deteriorated subjects. A.Sn., the psychoneurotic patient, rejoicing over a feeling of success in the recognition of the pictures, said "Of course, those pictures mean something. They're interesting. You couldn't help but know whether you had seen them or not. They were a pleasure to look at. The symbols don't mean anything to me." A normal subject, M.Co., commented, "There is so much that is different in the pictures, their form, color and subject matter, while with the symbols there is form only and no past experience."

Of the deteriorated cases only the seniles failed to get meaning out of the pictures. They had no appreciation of the unity, subject matter or details of the pictures presented for study.

The details of the pictures were listed after the observation period so that a check could be made in regard to whether the details not recognized in the test were stated earlier at the time of study.

Only a portion of the picture was shown in the test to make the problem somewhat similar to the test with the paired associates where one member of the pair was shown in the test. However, to give the subjects a chance to show what they could do when the whole picture was presented, the sorting test was added at the end of the other test.

Before giving the results on this test a word must be said in regard to the scoring of results. The method of treating the data for the comparison of results was the same for all tests and all subjects. Success in recall is reckoned in terms of the percentage of right answers given. To compare the recognition of the old with the recall of the old the percentage of the old correctly recognized was found. In showing the distinctive differences in response in the recognition of the old and new material the calculation of the probabilities for success with each type of material in a second series of trials was made.

The theoretical basis for such a procedure is stated as follows by C. R. Brown: "The interpretation of all experimental data necessarily rests upon comparisons in which due account of the statistical reliability of the differences is taken. This has usually been done by treatment of differences, whether qualitative or quantitative, and indices of reliability, *e.g.*, probable errors, as two distinct kinds of quantity or degree. The differences are customarily differences of 'scores' which are rather arbitrarily defined. A 'score' is, however, primarily a number not expressive of quantity but of frequency and has therefore the nature of a probability. Hence it falls logically in the same category with the index of reliability which also has meaning only in terms of probability. Hence there appears to be an advantage for some purposes, at any rate, in making comparisons in terms of one index of probability instead of two. This may be done in the following way. Suppose that an individual has succeeded p times in $p + q$ ($=n$) trials. 'P' or some number

derived from it is usually taken as the 'score,' but this obviously has meaning only in relation to n , and is subject to 'errors of sampling.' Hence in addition to n the 'probable error' must be specified. Instead, if one attacks the problem from the standpoint of Bayes' theorem, one may calculate the probability of s successes in a hypothetical repetition of the experiment involving m trials. This is given by the following formula:

$$\frac{(p+s)!(q+r)!(r+s)!(p+q+1)!}{p! \ q! \ s! \ r! \ (p+q+r+s+1)!} \quad \begin{matrix} (p+q=n) \\ (r+s=m) \end{matrix}$$

"Next a 'bogey' standard may be defined arbitrarily. Let the probability of success in $s, s+1, s+2, \dots, m$, trials in a total of m , be calculated and summed. There results then the probability of success in s or more trials, and if m be very large the result is the probability that the individual's ability is at least equal to that required by a 'bogey' standard of a ratio of successes to attempts at least as large as s/m . Hence the individual performance is compared directly with an arbitrary, but absolute 'bogey' standard, and the difference between the individual and 'bogey' is given in the probability value *to the extent to which it is statistically reliable*. Further many individuals may be compared with each other in terms of the comparisons of each with the same 'bogey' standard. Again if the same individuals have been subjected to different experiments, intra-experimental comparisons may be made in terms of 'bogey' standards so chosen that the corresponding probabilities are equal. Finally, if a normal or control group of individuals have been subjected to, say, two experiments, and the two standards have been chosen so that the probabilities are equal, the ratio of the latter is unity, which may be taken as the qualitative characterization of the control group with respect to the two experiments. Then, other groups having been subjected to the same two experiments, and the same 'bogey' standards having been applied, the corresponding probability ratios furnish a direct qualitative comparison with the control group, and again the *differences are given in terms of their respective reliabilities*."

With the normal individuals the probability of getting seven or more right out of ten was the standard set up with both old and new material except in those cases where the ratio between the old and new was not found to be 1. Here the standard was varied with the second group (the results with new material), until the ratio of 1 was obtained. Then this standard was maintained for the abnormal groups tested. Wherever this second standard was used it will be indicated in the tables of results and the expected number right out of ten will be stated.

The results with the picture series follow. The tables show the percentage of the old pictures recalled and recognized.

TABLE I
RECALL AND RECOGNITION OF PICTURES

Type	Number of Individuals	Percentage Free Recall	Percentage Recognition on Presentation of Part	Percentage Recognition by Sorting
Normal group	15	86.6	90.5	100.0
Abnormal group	20			
Senile.....	5	2.6	00.0	32.5
Presenile.....	3	45.8	41.6	87.5
General paralysis	4	56.2	56.2	84.3
Postenceph. case	1	No record	62.5	87.5
Korsakow case	1	00.0	00.0	87.5
Manic-depressive (depressed phase)...	2	68.7	31.2	100.0
Schizophrenia.....	3	87.5	100.0	87.5
Psychoneurosis.....	1	62.5	100.0	87.5

The second table gives the results on the recognition test. In the table R stands for right response, W for wrong, P for the probability scores.

TABLE II
RECOGNITION OF OLD AND NEW PICTURES

Type	No. of Each	Old			New			Ratio P. New P. Old	No Decision	
		R	W	P	R	W	P		Old	New
Normal	15	108	11	.98599	103	2	.99957	1.0153	1	
Abnormal	20									
Senile	5	0	24	.000017	21	0	.99409	5847.58	16	14
Pre-Sen.	3	10	14	.010969	20	1	.97114	88.53		
G.-P.	4	18	14	.64176	27	1	.98898	1.54		
Postenceph.	1	5	3	.42997	7	0	.93135	2.16		
Kors. case	1	0	8	.00238	7	0	.93135	391.32		
M.D. (Dep.)	2	5	11	.53927	14	0	.98338	1.82		
Schizoph.	3	24	0	1.28676	21	0	.99415	.772		
Psychoneur.	1	8	0	.94580	7	0	.93135	.984		

The errors made by all subjects for both the old and the new material were analyzed. With the old material a check was made as to whether the picture had been named at the free recall period and whether the portion used in the test had been described in the earlier observation period. The following tables show the results with the various types of cases with old and new material. The comments made by the subjects at the time of the test are included because they give a clue to the error made.

TABLE III

AN ANALYSIS OF THE ERRORS AND OMISSIONS MADE IN THE RECOGNITION OF OLD PICTURES BY THE NORMAL SUBJECTS

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
2	3	3		1	2	"Seems so queerly proportioned. No, not room for the little child in here. One (picture) had with basket at right but basket more in the background than this." E.R.S. F.L. "Just can't remember that part of the picture." C.D. "That's new. Don't recall seeing basket with great big ball in the center."
3	3	2	1		3	"Think I would have noticed that silly thing standing up." S.G. "Think that's new too. No mallard ducks in it." G.N. "That's new. Didn't have any yellow ducks" (yellow-green). M.S.
5	1	1			1	"I'll say that's new; might be either of two with ducks (but in one with all ducks No. 5) not so much unoccupied space. (Other) Boy in meadow, stream and grass (3) may be but hardly think so."
6	3	2	1	(3 . . .		but S.G. did not mention bluish-white color of the snow.) K.A. "Not sure about that, it seems to me that I had one with snow but can't remember what it was. I think I'd say that I hadn't seen it." S.G. first called it "water." When told it was snow commented "so blue" and let her response of "new" stand.

TABLE III (Continued)

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
7	1	1		1		M.K. could not reach a decision. "I couldn't tell about this one, just plain snow. It might be cut from the picture with bears but this is bluish-white; had remembered the other as clearer white except for deeper tone in the tracks and in the shadows of rocks."
8	1	1		1		"New (How did you recognize it?) peculiar color combination in the cobblestone formation." C.D. "Doesn't seem just like same windows; don't seem in right position, different, Dutch scene-night."

TABLE IV

AN ANALYSIS OF THE ERRORS MADE IN THE RECOGNITION OF THE NEW MATERIAL BY THE NORMAL SUBJECTS

Number of Picture	Number Making Error	Comments
13	2	This picture was shown prior to No. 6 to which it is similar and with which it was confused. "That's new—; (paused here, looked closer at the picture, then continued) oh, wait a minute, I think that's old bears in it." G.N. When No. 6 shown said, "Oh, that's old. I made a mistake on the other one. This is the one with the bears." "That may be old. Think that is the one that had three bears standing in the snow." C.D. When No. 6 shown said, "That's the one, the other one was wrong. (How did you recognize it?) Just the color of the snow—the formation that makes me sure."
Total	2	

The normal group made fourteen errors in all out of two hundred and twenty-five responses, or 6.2 per cent. In five cases of errors with the old, the right picture was recalled but the portion shown was rejected as not belonging to it. In the two cases of errors with the new, confusion resulted because of the similarity of the new to an old one.

No table is given of the results with the seniles because their responses fell into two classes; either no decision could be made or the response "new" was given. Of the five seniles two could not make any decisions about the pictures. The remaining three

said that all of the pictures were new. The characteristic response of one senile, M.McG., was the naming of a detail or two from the portion of the picture before her, followed by a judgment of "new." At the conclusion of the test she said, "I never saw the pictures; they're very nice though." The seniles had nearly as great difficulty in the sorting; the two who had been unable to make decisions before could not make them here. One senile, S.H., recognized three of the pictures and S.D. recognized two. A.C. reversed her tendency to call everything new when a portion of the picture was shown to calling everything old when the whole picture was shown. This does not indicate real recognition because of the fact that she also placed three of the new in the old pile.

TABLE V

ANALYSIS OF THE ERRORS MADE IN THE RECOGNITION OF THE OLD PICTURES
BY THE PRE-SENILE SUBJECTS

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
1	3		3		3	A.McC. gave it as new without comment. "Oh, say, look at the jewelry. There is a lady's hand tying a blue string around these pearls." H.N. "That is some baby's hand and some beads." F.S.
2	1		1		1	F.S. gave it as new without comment.
3	1		1		1	F.S. gave it as new without comment.
5	2	1	1		2	F.S. said "a summer scene in green," gave it as new. A.McC. said, "No, I didn't see that."
6	3	2	1	2	1	"Well, I don't think I saw it. It looks like sand to me. I'm quite sure that I never saw it." A.McC. "Nothing I saw. Just looks like the sky." H.N. F.S. just gave it as new without comment.
7	2	1	1	(2 . . .		but F.S. did not mention the cobblestones of the street.) F.S. and H.N. both said that they had not seen it before without further comment.
8	2	2			2	F.S. and H.N. both said that they had not seen it before without further comment.

H.N. gave one of the new pictures, No. 10, as old. She said, "It shows a part of a tree. Yes, I've seen it. There are ducks and little goslings, a boy and a boat, and a girl, seven years old, toddling about." Her comments showed that she might have had parts of three old pictures in mind: Picture No. 3 has little fowl, No. 5 has ducks and a tree which, however, is not similar in any way to the one in No. 10. Picture No. 4 has a boy, a boat and a little girl of approximately seven years who is sitting on the shore, not toddling about.

TABLE VI

ANALYSIS OF THE ERRORS MADE IN THE RECOGNITION OF THE OLD PICTURES
BY GENERAL PARALYSIS SUBJECTS

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
2	1	1		1		"New." "I don't believe you have (shown it) yet that ball in a basket is familiar in a room." V.M.
3	4	2	2	(4 . . .		though A.B. mentioned just the ducks and not the stream).
5	2	2		2		Both V.M. and A.P. said that it was new without further comment.
6	3	1	2	1	2	V.M. said, "It looks like ocean waves." When told that it was snow said, "It's new." A.P. said, "I don't believe I've seen it. Is that snow?" When told that it was she let it stand as new. J.O. commented, "That is a new picture with water." When told it was not water but snow, she added, "Yes, that's a new one, a snow scene."
7	2	2		(2 . . .		though V.M. made no mention of the cobblestones.) Both V.M. and J.O. made no further comment than that the picture was new.
8	2	1	1	2		A.P. said, "I don't believe I saw that. I don't remember seeing that window." J.O. remarked, "That I guess is a new one to me, a pretty house with a window there."

The general paralysis cases made fourteen errors out of thirty-two responses in the recognition of old material but they made no errors with the new.

The postencephalitic case made three mistakes with the old material. She had described the portions used in each of these pictures. With picture No. 3 her comment was, "I didn't see that. (H) I can tell it by that duckling, never saw it." With No. 5 she rejected it as old because she had not seen the flowers and grass. With No. 6 she commented, "I have seen something like that." To the question, "What is it?", she replied, "Water." To the comment, "No, it's snow," she replied, "No, I didn't see it." She made no errors with the recognition of the new pictures.

The Korsakow case gave all the old pictures as new. Her comment in each case was "I didn't see it." With No. 6 the experimenter then said, "No, it's snow," to which the patient added, "No, ma'am, I didn't see that."

TABLE VII

ANALYSIS OF THE ERRORS MADE IN THE RECOGNITION OF THE OLD PICTURES
BY MANIC-DEPRESSIVE, DEPRESSED PHASE SUBJECTS

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
1	1	1		1		"Isn't that cute? She's picking all those beads." C.H. At the time of seeing the picture for study her face had lighted up—"Oh isn't she cute? A beautiful little girl," was her first spontaneous remark about it and in the description among other details she stated, "There was a nice jewelry box and the little girl is pulling out the jewelry from the box."
2	1	1		1		"Never had a basket." P.A.
3	1		1	1		Simply said, "No ma'am, that's a new one." C.H.
4	1	1		(1 . . .		in part but had not mentioned sail-boat.) "Just like my little boy, a sail-boat. That's a new picture." C.H.
5	2	1	1	1	1	"No m'am, that's new too." C.H. "No, I haven't seen that, green looks like a forest. Don't remember seeing a forest." P.A.

TABLE VII (Continued)

No. of Picture	No. Making Error	Picture Given in Free Recall		Portion Described Earlier		Comments
		Yes	No	Yes	No	
6	2	1	1	2		"No, I didn't see that, looks like water." P.A. "Oh, this is just a big sea. Didn't see before." C.H. At the time of observation C.H. had said aloud, "White animals already on the ocean. Is that an ocean? (No comment made by experimenter.) It seems to me there is water here. During the description of details said, "That bear is walking around on the field . . . walking around with two little bears."
7	1		1	1		"It's a street scene. I saw one but don't think that was the one. It seems like flooring pavement—foreign country."
8	2	1	1	2		"No, I didn't see that. It looks like doors in some building." P.A. "There is a window. No, ma'am, new." C.H.

The manic depressive cases made eleven errors with the old material but had no trouble with the new.

The schizophrenia cases recognized correctly both the old and the new material.

The psychoneurotic patient also made perfect scores. She showed a great deal of emotion about the pictures. Those of the children brought forth comments about her own lack of beauty with further remarks about her "unutterable ugliness." The one of the house made her think of her father whose life she had "wrecked" and lead to statements about the flat in Detroit where she kept house for her father and spent the happiest days of her life. The village church picture of the test caused her such distress that she got up and walked about the room accusing the experimenter of cruelty in tormenting her with memories. When she resumed her seat she sat with her face covered by her hands and swayed backward and forward. When she became calmer the experimenter asked what associations were called to mind by the picture. She then told of happy times when

she had gone to the art gallery in Detroit with her father and of how they had looked at just such a picture as the one shown. She went into great detail about her devotion to her father. Instances of disturbances of this kind only emphasize the value for psychological work of using material free from association in the past. No reactions of this sort were evidenced with the nonsense material. Occasionally annoyance at a feeling of failure with the material was shown but it was not such as to interfere appreciably with the performance of the task. One patient, U.B., who had been used as a subject over a four months' period complained of boredom at the monotony of the tests, *i.e.*, the use of the same type of material and the same procedure with the six tests of each series. However, here too there seemed to be no interference with her success. She was told that she need not continue if she did not wish to do so. She continued for a time regarding the tests as a means of whiling away time but she finally asked to be excused from further tests.

The seniles and Korsakow case failed entirely in the recognition of old material. The next groups to make many errors were the manic-depressive group where 68.7 per cent of the old material was given as new, the pre-senile group with 58.3 per cent of the old given as new, and the general paralysis cases with 43.6 per cent of the old given as new.

Series II. Chinese Symbols with their English Equivalents.

Five normal subjects and five abnormal ones took part in this experiment. The abnormal represented four cases of schizophrenia, J.P., J.K., U.B., M.N., and one case of manic depressive psychosis, manic state, A.St. The group was again divided into two, those that were tested by the showing of the first members of the pairs only and those that were tested with both members of the pairs. There were twenty judgments per test in the former case and forty per test in the latter. Two schizophrenics, J.K. and J.P., and three normals were in the first group. Their results on the recognition test were as follows:

TABLE IX
A. CHINESE SYMBOLS

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P. +8 Out of 10	Ratio P. New P. Old
<i>Normal Subjects</i>							
1	7	7		5	1		
2	10	4		6	0		
3	7	7		3	3		
4	8	6		5	1		
5	11	3		5	1		
Totals	43	27	.41682	24	6	.62020	1.488
<i>Schizophrenia Cases</i>							
1	8	20		12	0		
2	9	19		10	2		
3	9	19		12	0		
4	15	13		12	0		
5	14	14		12	0		
Totals	55	85	.06070	58	2	.98212	16.18

The marked tendency of the schizophrenics to call everything new when tested with the Chinese symbols only is shown in the probabilities. The probability of getting seven old right out of ten being very low (.06070) while that of getting eight new right out of ten was high (.98212). The ratio was 16.18. This is 10.8 times greater than the ratio of the normal subjects.

The results where both members of the pairs were tested are given below. Table X gives the responses with the Chinese symbols while table XI gives the responses with the English equivalents.

TABLE X
A. CHINESE SYMBOLS

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P. +8 Out of 10	Ratio P. New P. Old
<i>Normal Group</i>							
1 (2)	20	8	.63950	7	5	.72654	1.136
<i>Schizophrenia Group</i>							
1 (2)	26	2		9	3		
2 (2)	22	6		9	3		
3 (2)	25	3		10	2		
4 (2)	22	6		11	1		
5 (2)	24	4		7	5		
Totals	119	21	.94044	46	14	.55959	.595

TABLE X (Continued)

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P. +8 Out of 10	Ratio P. New P. Old
<i>Manic State</i>							
1 (1)	10	4		6	0		
2 (1)	11	3		4	2		
3 (1)	12	2		6	0		
4 (1)	11	2		5	1		
5 (1)	13	1		6	0		
Totals	57	12	.89349	27	3	.85662	.958

TABLE XI

B. ENGLISH EQUIVALENTS

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P. +2 Out of 10	Ratio P. New P. Old
<i>Normal Group</i>							
1 (2)	26	2	.97154	6	6	.91414	.94
<i>Schizophrenia Group</i>							
1 (2)	24	4		8	4		
2 (2)	21	7		12	0		
3 (2)	22	6		12	0		
4 (2)	24	4		12	0		
5 (2)	24	4		11	1		
Totals	115	25	1.54822	55	5	.98484	.636
<i>Manic State</i>							
1 (1)	12	2		6	0		
2 (1)	6	7		4	2		
3 (1)	10	4		5	1		
4 (1)	8	6		6	0		
5 (1)	8	5		6	0		
Totals	44	24	.46865	27	3	.99996	2.13

The group of schizophrenic subjects tested with both members of the pair did not show the same tendency as the group tried with the Chinese symbols only. With the group tested with both members the probability of getting seven out of ten was high (.94044) while the probability of getting eight new out of ten was not very high (.55959). The ratio was only .524 that of the normal group. This difference may have been due to J.K., a member of the group tested with Chinese symbols only who showed a decided tendency to call everything new and whose inaccessibility and lack of comment made it impossible to get any

check on her reasons for calling the material new or to determine whether her responses were simply stereotyped ones.

The one manic subject made a higher probability score with both the old and the new with a ratio approximately that of the normal group.

In the results when the English equivalents were shown it was necessary to get the probability for the new on the basis of two right out of ten in order to get a ratio of approximately 1. for the normal group. This seems to indicate a tendency to call all the English equivalents old. The schizophrenics showed the same tendency as they had with the Chinese, that is to get a ratio which was .676 of the normal. The manic case had a ratio of 2.2 times that of the normal, which varied from the results with the Chinese symbols.

The results were based on the following number of judgments: In the group where one member only was tried on 100 judgments of normal subjects and 200 judgments of the schizophrenic subjects. In the group where both members were tested on 80 judgments of the normal group, 400 for the schizophrenic and 197 for the manic. The value of having more subjects in each group and more judgments for each subject cannot be lost sight of.

Neither abnormal group was especially successful with the recall of associates. With the recall by schizophrenics of the English equivalents when the Chinese members of the pair was the only one shown twelve recalls out of a possible 140 were made, *i.e.*, 8.5 per cent, but of these only nine were correct, giving a percentage of correct recall 6.4 per cent. The second group of schizophrenics tested with both members of the pair recalled 18 out of a possible 140 or 12 per cent:—of these, ten were correct or 7 per cent. The manic case recalled only 4 per cent and none of the associates recalled were correct. When the English member was shown the schizophrenics increased their percentage of recall to 18 per cent (or 26 out of 140), while none of the associates given were correct. The manic case gave a 12 per cent recall with none of these correct.

In the earlier experimental work with the recognition of

Chinese symbols (Wylie (32)) the untrained normal subjects when shown the Chinese gave a 7.6 per cent correct recall and when shown the English to give the associate had 9/10 of 1 per cent correct, so that the normals and abnormals showed little difference in their results.

Series III, Chinese symbols paired with Romanized equivalents. Three intervals of test: twenty minutes; one hour and twenty-four hours.

Twenty-Minute Interval.

In the first part of this experiment, the twenty-minute interval, three normals and three abnormals took part. The abnormals were two schizophrenics and one manic depressive, manic state. The results showed no marked differences between the normal and schizophrenic groups but the manic depressive, manic state, showed a ratio which was .39 of the normal, both with the Chinese and the Romanized syllables. The results were based on 310 judgments of normal subjects, 343 judgments of schizophrenic subjects and 270 judgments of the manic depressive subjects.

Table XII gives the results on the recognition tests of the normal subjects. Table XIII gives the results for the abnormal.

TABLE XII
SERIES III. CHINESE SYMBOLS AND ROMANIZED SYLLABLES.
TWENTY MINUTE INTERVAL.

<i>Normal Individuals</i>							
	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio P. New P. Old
A. Chinese Symbols							
1 (3)	32	10		17	1		
2 (3)	37	5		16	2		
3 (2)	23	5		7	5		
5 (1)	13	1		6	0		
Totals	105	21	.91579	46	8	.92221	1.007
B. Romanized Symbols							
				* 6 Out of 10			
1 (3)	23	7		9	0		
2 (3)	26	4		12	3		
3 (2)	20	2		6	4		
5 (1)	8	2		4	0		
Totals	77	15	.89926	31	7	.99992	1.111

In the recall of associates the normals with the Chinese recalled 46 per cent (58 out of 126) and a correct recall of 19 per cent (24 out of 126). With the Romanized the normals recalled 22.2 per cent (28 out of 126) and a correct recall of 7.1 per cent (9 out of 126). The abnormals showed a recall of 6.7 per cent (14 out of 208); with the Romanized they recalled 37.5 per cent

TABLE XIII

SERIES III. CHINESE SYMBOLS AND ROMANIZED SYLLABLES.

TWENTY MINUTE INTERVAL. ABNORMAL CASES.

I. *Schizophrenia* (Two Subjects)

	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio P. New P. Old
A. Chinese Symbols							
1	22	6		10	2		
2	20	8		12	0		
3	21	7		12	0		
4	22	6		10	2		
5	24	4		9	3		
Totals	109	31	.81635	53	7	.95830	1.173

B. Romanized Syllables

* 6 Out of 10

1	18	0		6	0		
2	17	3		9	1		
3	19	3		7	3		
4	18	4		5	3		
5	17	3		7	0		
Totals	89	13	.95765	34	7	.96118	1.003

Manic-Depressive—Manic State (One Subject)

A. Chinese Symbols

1	14	0		1	5		
2	13	1		5	1		
3	12	2		4	2		
4	12	1		6	0		
5	11	2		2	4		
Totals	62	6	.98041	18	12	.38797	.395

B. Romanized Syllables

* 6 Out of 10

1 (1)	9	0		3	0		
2 (1)	10	0		2	3		
3 (1)	11	0		2	3		
4 (1)	11	0		1	3		
5 (1)	10	0		3	1		
Totals	51	0	.99961	11	10	.44454	.44471

(78 out of 208) and a correct recall of 8.6 per cent (18 out of 208). Of the abnormals the schizophrenics recalled with the Chinese 21.4 per cent (30 out of 140) and a correct recall of 8.5 per cent (12 out of 140); with the Romanized 27.1 per cent (38 out of 140) and 10 per cent correct (14 out of 140). The manic depressive, manic state, recalled 29 per cent (20 out of 68) of the Chinese and a correct recall of 2.9 per cent (2 out of 68), while with the Romanized 58.8 per cent (40 out of 68) and a correct recall of 5.8 per cent (4 out of 68).

No opportunity was given for free recall.

One-hour Interval

In the one-hour interval tests five normals took part in series 1 to 5, giving 763 judgments, and five other normals in series 6 to 10, giving 887 judgments or 1650 judgments in all. Nine abnormal cases took part in these tests. Two schizophrenics (351 judgments); one psychoneurotic (172 judgments) and one manic depressive, depressed phase (68 judgments), took part in series 1 to 5, giving 591 judgments. Two manic depressive, depressed phase (342 judgments), one hypomanic (70 judgments) and two psychopathic personalities (246 judgments) took part in series 6 to 10, giving 658 judgments. This made a total of 1249 judgments for the abnormal.

The results in the recognition tests are shown in Tables XIV and XV.

In the recognition tests the abnormals differed considerably from the normal subjects. With the normals the ratio was the same both for the Chinese and the Romanized. With the abnormals this was only approximately true of the psychoneurotic where the ratio for the Romanized was .008 and that for the Chinese .000. The other abnormals ranged as follows in the number of times larger the ratio of Romanized syllables was to that of the Chinese: schizophrenics, 9.7; hypomanic, 21.5; manic depressive, depressed, 29.2; while the ratio of psychopathic personality was .000 for the Chinese and .780 for the Romanized. This would seem to indicate that for the normals and the psychoneurotics the Chinese and Romanized material were about equally

recognizable, in the former case easily recognizable, in the latter case, unrecognizable, but that for the others the Romanized material showed a greater probability of being recognized in no case, however, equal to that of the normal. It ranged from .6 of the normal (psychoneurotic) up to 1.56 greater than the normal (hypomaniac) with the following between manic depres-

TABLE XIV

SERIES III. CHINESE SYMBOLS AND ROMANIZED SYLLABLES. ONE HOUR INTERVAL TEST WITH NORMAL SUBJECTS.

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio	No	
							P. New	Decision	Old
A. Chinese Symbols									
* 9 Out of 10									
1 (4)	33	22		19	5			1	
2 (4)	34	22		23	1				
3 (5)	45	24		29	1				
4 (5)	54	16		25	4				1
5 (4)	41	15		23	1				
6 (5)	35	35		26	4				
7 (5)	43	27		17	13				
8 (5)	42	28		26	4				
9 (5)	35	35		19	11				
10 (5)	43	27		27	3				
Totals	405	251	.36945	234	47	.47745	1.292		
B. Romanized Syllables									
1 (4)	30	10		10	2				
2 (4)	29	11		16	4				
3 (5)	40	15		18	6				
4 (5)	36	19		17	5				
5 (4)	31	9		16					
6 (5)	39	11		22	3				
7 (5)	33	29		12	8				
8 (5)	35	20		16	4				
9 (5)	41	14		17	3				
10 (5)	44	11		18	7				
Totals	358	149	.66282	162	42	.85832	1.294	1	1

sive, depressed .38 of the normal, schizophrenic .44 of the normal, psychopathic personality .60 of the normal.

In free recall the normals recalled of a possible 350 Chinese symbols 40. Of these 5 were correct or 1.4 per cent of the total. With the same number of Romanized 97 were recalled. Of these 66 were correct or 18 per cent of the total.

TABLE XV
 SERIES III. CHINESE SYMBOLS AND ROMANIZED SYLLABLES.
 ONE HOUR INTERVAL. ABNORMAL CASES.

I. *Schizophrenia* (Two Subjects)

1. Schizophrenia (Two Subjects)									
Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio P. New	No Decision	
							P. Old	Old	New
A. Chinese Symbols									
* 9 Out of 10									
1	23	5		8	4				
2	18	10		7	5				
3	18	10		4	8				
4	20	8		5	7				
5	18	10		4	8				
Totals	97	43	.62126	28	32	.00991	.059		
B. Romanized Syllables									
1	14	12		5					
2	11	9		5	5				
3	16	6		5	5				
4	14	8		4	4				
5	17	3		5	3				
Totals	72	38	.52025	24	17	.29850	.573		

II. *Psychoneurosis* (One Subject)

A. Chinese Symbols									
* 9 Out of 10									
1	10	2		1	2			2	3
2	12	0		1	4			2	2
3	11	1		0	6			2	
4	9	3		2	4				
5	7	0		0	4			7	2
Totals	49	6	.96272	4	20	.00008	.000	13	7
B. Romanized Syllables									
1	9	1		0	2			0	1
2	8	0		0	2			2	3
3	8	1		1	4			2	
4	11	0		0	4				
5	10	0		2	2				
Totals	46	2	.99424	3	14	.00800	.008	4	4

III. *Manic-Depressive, Depressed Phase* (Series 1, 2, One Subject;
 Series 6-10, Two Subjects)

A. Chinese Symbols									
* 9 Out of 10									
1	10	4		1	5				
2	13	1		1	5				
6	20	8		5	7				
7	18	10		5	7				
8	19	9		6	6				
9	21	7		6	6				
10	21	7		6	6				
Totals	122	46	.70744	30	32	.01261	.017		

TABLE XV (Continued)

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio	No Decision	
							P. New		
							P. Old	Old	New
B. Romanized Syllables									
1	10	0		3	0				
2	10	0		1	4				
6	15	5		8	2				
7	16	6		4	4				
8	19	3		6	2				
9	17	5		4	4				
10	14	8		6	4				
Totals	101	27	.84484	32	20	.42120	.498		

III-B. *Manic-Depressive, Hypomania* (One Subject)

A. Chinese Symbols

* 9 Out of 10

6	9	5		4	1					
7	8	5		1	4					1
Totals	17	10	.45094	5	5	.04257	.094			1

B. Romanized Syllables

6	6	4		4	1					1
7	5	6		2	2					1
Totals	11	10	.25251	6	3	.51164	2.026			2

IV. *Psychopathic Personality* (Series, 6, 7, Two Subjects;
Series 8-10, One Subject)

A. Chinese Symbols

* 9 Out of 10

6	21	7		10	2					
7	21	7		4	8					
8	10	4		1	5					
9	12	2		1	5					
10	12	2		2	4					
Totals	76	22	.81137	18	24	.00668	.000			

B. Romanized Syllables

6	12	8		8	2					
7	15	7		5	3					
8	9	2		3	1					
9	11	0		2	2					
10	8	3		3	2					
Totals	55	20	.71252	21	10	.55975	.785			

In the recall of associates with a possible 350 Chinese symbols the normals recalled 58 associates, of these 22 or 6.2 per cent were correct. With the same number of Romanized 33 associates were given. Of these 8 or 2.2 per cent were correct.

In free recall the abnormals recalled of a possible 252 Chinese

23. Of these only one was correct or .39 of 1 per cent. With the same number of Romanized 45 were given. Of these 22 or 8 per cent of the total possible number were correct.

In the recall of associates with a possible 266 Chinese symbols, 40 associates were given. Of these 10 were correct or 3.6 per cent of the total. With the same number of Romanized 23 associates were recalled. Of these 3 were correct or 1.1 per cent of the total.

Twenty-four Hour Interval

For the twenty-four hour test there were six normal subjects. One of them had series 1 to 5, one had series 6 to 8 and four had series 6 to 10. There were 975 judgments in all; 179 judgments series 1 to 5, 796 judgments series 6 to 10. There were seven abnormal subjects who took part in this experiment. In series 1 to 5 one manic depressive, depressed, gave 206 judgments and one psychopathic personality 104 judgments. In series 6 to 10 three schizophrenics gave 457 judgments, one manic depressive, manic state, gave 182 judgments and one psychoneurotic gave 177 judgments making a total of 1126 judgments.

In the recognition tests the schizophrenics did as well as the normals, 1.10 of the normal with the Chinese and .92 of the normal with the Romanized. The psychoneurotic failed completely with both Chinese and Romanized. The manic depressive, depressed, did better with the Romanized than with the Chinese; .012 of the normal with the Chinese and .293 of normal with the Romanized. The manic depressive, manic state, on the other hand, did better with the Romanized than with the Chinese; .18 of the normal with the Chinese and only .005 of the normal with the Romanized. The psychopathic personality case showed the greatest discrepancy between her responses. She showed with the Chinese a probability three times (3.09) that of the normal but with the Romanized .273 of the normal.

Table XVI gives the results on the recognition tests after a twenty-four hour interval for the normal subjects with both the Chinese symbols and Romanized syllables. Table XVII gives the same data for the abnormal subjects.

In free recall out of a possible 322 Chinese symbols 43 or 13.3 per cent were recalled by the normal subjects but only 5 of these were correct. Thus the percentage of correct recall was but 1.5 per cent. With the same number of Romanized syllables 75 or 23.2 per cent were recalled. Of these 44 or 13.6 per cent were correct. The abnormals recalled only one Chinese of a possible

TABLE XVI

SERIES III. TWENTY-FOUR HOUR INTERVAL. NORMAL SUBJECTS.
(Six Subjects, four had Series 6-10, one had 1-5 and one 6-8.)

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio	No	
							P. New	Decision	
							P. Old	Old	New
A. Chinese Symbols									
1	7	7		3	3				
2	10	4		6	0				
3	9	5		3	3				
4	8	6		4	2				
5	7	7		3	3				
6	39	26		20	9			5	1
7	52	17		20	10				
8	42	26		22	8			2	
9	38	18		11	13				
10	40	16		14	10				
Totals	252	132	.52777	106	61	.49866	.944	7	1
B. Romanized Syllables (8 out of 10)									
1	6	4		3	0				
2	7	3		6	3				
3	7	4		3	1				
4	7	4		4	3				
5	6	4		3	1				
6	35	14		21	4				
7	41	11		6	14				
8	41	12		13	7				
9	36	8		7	9				
10	40	4		8	12				
Totals	226	68	.81070	68	54	.96107	1.185		

42 and this was incorrect. Twelve Romanized out of 42 were recalled, of these 9 were correct, making 21.4 per cent of the total possible number correct.

In the recall of associates out of a possible 322 Chinese symbols 52 associates were recalled by the normal subjects. Of these 21 were correct, making 6.5 per cent of the possible correct recalls. With the 322 Romanized 55 associates were recalled by the

normal subjects. Nine of these were correct, making 2.7 per cent of the possible recalls.

In the recall of associates by the abnormal out of a possible 322 Chinese—23 associates were recalled; of these 4 were correct or 1.2 per cent of the total possible. With 322 Romanized 70 associates were recalled. Of these only 1 was right or .3 per cent of the total possible.

TABLE XVII

SERIES III. TWENTY-FOUR HOUR INTERVAL. ABNORMAL CASES.

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio	No	
							P. New	P. Old	Decision
I. <i>Schizophrenia</i> (Three Subjects—Series 6-10; two, Series 6-8, three)									
A. Chinese Symbols									
6	24	18		11	7				
7	25	17		9	9				
8	34	8		10	8				
9	16	12		11	1				
10	14	14		8	4				
Totals	113	69	.43537	49	29	.45251	1.039		
B. Romanized Syllables									
6	19	11		11	4				
7	23	10		7	5				
8	26	7		6	6				
9	11	11		6	2				
10	15	7		10	0				
Totals	94	46	.33287	40	17	.36324	1.091		
II. <i>Psychoneurosis</i> (One Subject)									
A. Chinese Symbols									
6	11	3		0	6				
7	9	5		4	2				2
8	8	6		2	4				
9	11	0		0	6				3
10	11	2		0	5				1
Totals	50	16	.76422	6	23	.00634	.008	6	2
B. Romanized Syllables									
6	9	0		0	4				1
7	8	1		0	2				2
8	10	0		0	3				1
9	11	0		0	4				
10	10	1		1	4				
Totals	48	2	.97242	1	17	.00009	.00009	4	2

TABLE XVII (Continued)

III-A. *Manic-Depressive-Depressed Phase* (Two Subjects—
one Series 1 only, other 1-5)

Test Series Number	Old Right	Old Wrong	P.	New Right	New Wrong	P.	Ratio P. New P. Old	No Decision	
								Old	New
1	19	9		8	4				
2	12	2		1	5				
3	13	1		0	6				
4	12	2		0	6				
5	12	2		0	6				
Totals	68	16	.87172	9	27	.01115	.012		

B. Romanized Syllables

1	17	3		2	4				
2	9	1		2	3				
3	11	0		1	4				
4	7	4		2	2				
5	6	4		2	2				
Totals	50	12	.65366	9	15	.22749	.348		

III-B. *Manic-Depressive, Manic State* (One Subject)

A. Chinese Symbols

6	13	0		3	3			1	
7	11	3		2	3				1
8	14	0		3	3				
9	14	0		1	5				
10	14	0		1	5				
Totals	66	3	.91275	10	19	.16326	.178	1	1

B. Romanized Syllables

6	10	0		3	5				
7	9	0		2	4				
8	11	0		3	3				
9	11	0		1	4				
10	11	0		1	4				
Totals	52	0	.99697	10	20	.006604	.006		

IV. *Psychopathic Personality* (One Case)

A. Chinese Symbols

1	11	3		3	3				
2	9	5		1	5				
3	9	5		4	2				
Totals	29	13	.59728	8	10	.17459	2.923		

B. Romanized Syllables

1	9	1		1	2				
2	7	3		1	4				
3	8	3		2	3				
Totals	24	7	.55614	4	9	.01803	.324		

In free recall the abnormal subject did 1.5 per cent less than the normal with the Chinese and 7.8 per cent more than the normal with the Romanized.

In the recall of associates the abnormal did 5.3 per cent less than the normal with the Chinese and 2.4 per cent less than the normal with the Romanized.

Series IV. Chinese Symbols and Nonsense Syllables

Three types of cases took part in the Chinese symbol and nonsense syllable experiment. There were two normal subjects and nine abnormal ones. The abnormal group was made up of three preseniles and six seniles. Each subject had a preliminary series similar to the later tests except if not recalled the repetitions were continued up to 100 and given at several sittings.

At the end of each showing of the series an immediate test for recall was given. The series was continued until all six nonsense syllables were recalled—regardless of the order except if not recalled after the fiftieth repetition no further repetitions were given. Due to the fact that both the senile and preseniles disregarded the Chinese symbols entirely the results are those with the nonsense syllable only considered. At the end of the third repetition a recognition test took place. There were six new pairs added. Both members of the pair were exposed at the same time because of the disregard shown by the seniles and preseniles to the Chinese symbol. A comparison of the results for immediate recall and recognition at the end of the third repetition can be made from the following table:

TABLE XVIII

SERIES IV. RELATION BETWEEN IMMEDIATE RECALL AND RECOGNITION
AT THE END OF THE THIRD REPETITION.

Type of Case	No. of Individuals	No. of Tests	Per cent Success Free Recall	Per cent Recognition Old R
Normal.....	2	8	76.3	83.3
Pre-senile.....	3	15	31.4	63.3
Senile.....	6	29	9.9	41.9

Here it is seen that all groups show higher percentages with recognition than with recall but the difference with the normal is

only 7 per cent while with the other two groups it is 32 per cent in each case or four and one-half times the normal.

When the recognition of both old and new are considered, in the ratio of their probabilities, the preseniles have a ratio 1.59 times that of the normal, while the seniles have one 8.51 times that of the normal.

Table XIX shows this relationship.

TABLE XIX

SERIES IV. CHINESE SYMBOLS PAIRED WITH NONSENSE SYLLABLES.

RECOGNITION AFTER THE THIRD REPETITION.

<i>Normal Group</i>									
Test Number	Number Taking Test	Old Right	Old Wrong	P.	New Right	New Wrong	P.	No Decision Old New	
1	2	6	6		12	0			
2	2	10	2		12	0			
3	2	12	0		12	0			
4	1	6	0		6	0			
5	1	6	0	.89526	6	0	1.19762		1.33773
Totals	8	40	8		48	0			
<i>Abnormal Group: Pre-Senile</i>									
1	3	11	7		17	1			
2	3	11	7		15	2			
3	3	10	8		18	0			
4	3	12	6		17	1			
5	3	13	5	.46559	17	1	.99477		2.13657
Totals	15	57	33		84	5			1
<i>Abnormal Group: Senile</i>									
1	6	15	20		31	5		1	
2	6	15	21		26	10			
3	6	16	15		22	11		5	3
4	6	15	20		26	10		1	
5	5	12	18	.09702	18	12	1.10449		11.38411
Totals	29	73	94		123	48		7	3

After the recognition test the series was continued to see how many repetitions would be required for recalling all six nonsense syllables. A test was made at the close of each repetition. The seniles did not complete the giving of all six at the end of the fiftieth repetition. In the preliminary series tried out they did no better with 100 repetitions so the number was cut to 50.

The six members of the series were ranked for their order of appearance in recall, one being the one to come in first. Then

the number of such rankings received by each number of the series was totaled for the group and the results ranked, the one having the most being one. There was noted a distinct difference between the groups in this regard. There was a split between the normal on the one hand and the senile and presenile groups on the other. The normal individuals began building their series from the first member on, not so much as a matter of primacy effect it seems to me as from the tendency to hold things in their serial order. In the other two groups the opposite tendency was noted. Here the last places were ranked highest. This I feel was not due to any backward running association or building the series up from the last but seemed to be due to the factor of recency and the brief duration of the memory image. The limited span included most frequently the last or the last two numbers of the series. Ability to hold things in serial order appeared to be lost. This was also shown on the picture test where the seniles could not arrange the series in the order it had been originally shown them. The preseniles also had difficulty. The normal individuals had no difficulty in remembering by order of sittings but occasionally were unable to tell which was shown first and which second at any one sitting.

Table XX shows the distribution of responses for the different members of the series with the total percentage recalled of each member of the series for the three groups.

Series V. Paired Nonsense Syllables

This test was taken by nine normal subjects and twelve abnormal ones. The abnormals were grouped as follows: seniles, four; preseniles, three; general paresics, four; Korsakow case, one, and post-encephalitic case, one.

At the end of five repetitions free recall was asked for of as many of both members of the six pairs. Then six new pairs were added. The subject was then tested with the first members of the old and new pairs and asked to give the associate or second member when the first member was recognized. Table XXI gives the results for recognition after the first five repetitions.

Here it will be seen that the normals were equally able to recognize both new and old. The seniles showed inability with the old material which was regarded by them as new. The Korsakow case showed the opposite tendency of regarding all the

TABLE XX

SERIES IV. CHINESE SYMBOLS PAIRED WITH NONSENSE SYLLABLES.
SUCCESSFUL IMMEDIATE RECALL OF MEMBERS OF THE SERIES.

Test Number	Number Taking Test	Average Number Repetitions Given	Number Recalled of Each Member of the Series						Total
			Members of the Series						
			1	2	3	4	5	6	
<i>Normal Subjects</i>									
1	2	4	7	7	6	4	5	3	32
2	2	1.5	3	3	1	2	0	2	11
3	2	1.5	3	1	3	3	0	1	11
4	1	2	2	0	2	1	2	2	9
5	1	1	1	1	0	0	1	1	4
Totals			16	12	12	10	8	9	67
Percentages			94.1	70.5	70.5	58.8	47	52.9	65.6
Ranks			1	2.5	2.5	4	6	5	
<i>Abnormal Subjects: Pre-Senile Group</i>									
1	3	23	15	17	17	28	7	58	142
2	3	26	12	11	17	34	41	73	188
3	3	26	40	10	24	16	61	55	206
4	3	19	8	2	19	27	43	47	146
5	3	23	20	12	6	22	22	40	131
Totals			95	52	83	127	174	282	813
Percentages			26.2	14.3	22.9	35	48	77.9	37.4
Ranks			4	6	5	3	2	1	
<i>Abnormal Subjects: Senile Group</i>									
1	6	50	16	10	0	37	37	154	254
2	6	50	4	40	4	11	51	97	207
3	6	50	25	1	3	11	59	96	195
4	6	50	1	20	6	3	42	98	189
5	5	50	3	22	3	1	39	72	140
Totals			49	93	16	63	228	517	985
Percentages			3.3	6.4	1.1	4.3	15.7	35.6	11.3
Ranks			5	3	6	4	2	1	

new as old. The presenile and post-encephalitic showed a higher probability with the new than the old though in neither case did it come up to the normal. The general parietic cases showed a higher probability with the old though here again the result was lower than that of the normals.

TABLE XXI

PAIRED NONSENSE SYLLABLES: RECOGNITION TEST AFTER FIVE REPETITIONS
(FIRST MEMBERS SHOWN).

Normal Group (Nine Subjects)

Test Number	No Decision		Number of Old R.	Old W.	P.	New R.	New W.	P.	Ratio P. New P. Old
	Old	New							
1 (4)			22	2		20	4		
2 (4)			23	1		23	1		
3 (5)			30	2		30	0		
4 (6)			31	5		34	2		
5 (7)			40	2		42	0		
Totals			144	12	.99152	149	7	.99819	1.00672

Abnormal Group: Senile (Four Subjects)

1 (4)		4	20			19	5		
2 (3)		6	12			18	0		
3 (3)		0	18			6	12		
4 (3)		2	16			13	5		
5 (3)		1	17			16	2		
Totals		13	83	.00041		72	24	.75592	1843.7073

Abnormal Group: Pre-Senile (Three Subjects)

1 (3)	1	12	4			16	1		
2 (3)		12	6			17	1		
3 (3)		13	5			11	7		
4 (3)		14	4			17	1		
5 (3)		15	3			13	5		
Totals		66	22	.57623		74	15	.75903	1.32723

Abnormal Group: General Paralysis (Four Subjects)

1 (4)		18	6			17	7		
2 (4)		16	8			21	3		
3 (4)		17	7			14	10		
4 (4)		22	2			17	7		
5 (4)		20	4			17	7		
Totals		93	27	.81396		86	34	.68167	.83747

Abnormal Group: Korsakow Case (One Subject)

1 (1)		6	0			1	5		
2 (1)		6	0			1	5		
3 (1)		6	0			1	5		
Totals		18	0	1.45312		3	15	.00619	.00425

Abnormal Group: Postencephalitic Case (One Subject)

1 (1)		5	1			6	0		
2 (1)		4	2			6	0		
3 (1)		3	3			3	3		
Totals		12	6	.39328		15	3	.83936	2.13425

The results of free recall after five repetitions and before the recognition test and of recall of the associate during the recognition test are given in Tables XXII-a and XXII-b.

TABLE XXII-A

RELATION OF RECOGNITION AND RECALL: SERIES V, TESTS 1-5,
IMMEDIATELY AFTER FIVE REPETITIONS.

Type of Case	Total Number of Tests	Free Recall of First Member	Free Recall of Second Member
Normal	156	66.6%	64.7%
Abnormal			
Seniles	96	01.0%	5.2%
Pre-Seniles	90	26.6%	30.0%
Gen. Paralysis	120	12.5%	11.6%
Post-Enceph.	18	22.2%	33.3%
Korsakow case	18	00.0%	5.5%

TABLE XXII-B

Type of Case	Total Number of Tests	First Member Shown and Correctly Recognized	Second Member Recalled as Associate when First Member Shown and Recognized
Normal	156	92.3%	55.7%
Abnormal			
Seniles	96	12.5%	00.0%
Pre-Seniles	90	74.4%	12.2%
Gen. Paralysis	120	76.6%	7.5%
Post-Enceph.	18	66.6%	00.0%
Korsakow case	18	100.0%	00.0%

After ten repetitions another period of free recall was given. Then another set of six new pairs was mixed with the old. A recognition test was given showing the second members of the pairs. Whenever one was recognized the subject was asked to give if possible the first member of the pair. The results for the recognition are given in Table XXIII.

The normals showed a slightly higher probability with the old members. The post-encephalitic showed even higher probability with the old than the normals had. The presenile and general paretic showed the same probability with both old and new. The seniles again showed inability with the old material which they recognized as new. The Korsakow case showed the opposite tendency of regarding all the new as old.

The results of free recall after ten repetitions and before the recognition test and of recall of the associate during the recognition test are given in Tables XXIV-a and XXIV-b.

TABLE XXIII

SERIES V. PAIRED NONSENSE SYLLABLES: RECOGNITION TEST AFTER
TEN REPETITIONS.

Test Number	Old R.	Old W.	P.	New R.	New W.	P.	Ratio
<i>Normal Group (Seven Subjects)</i>							
1 (4)	24	0		23	1		
2 (4)	24	0		24	0		
3 (5)	30	0		30	0		
4 (6)	33	3		35	1		
5 (7)	41	1		42	0		
Totals	152	4	1.02607	154	2	.99989	.97388
<i>Abnormal Group: Senile (Four Subjects)</i>							
1 (4)	8	16		19	5		
2 (3)	5	13		16	2		
3 (3)	3	15		8	10		
4 (3)	2	16		17	1		
5 (3)	6	12		15	3		
Totals	24	72	.02021	75	21	.82254	40.69965
<i>Abnormal Group: Pre-Senile (Three Subjects)</i>							
1 (3)	13	4		17	0		
2 (3)	15	3		18	0		
3 (3)	17	1		15	3		
4 (3)	13	5		14	4		
5 (3)	18	0		13	5		
Totals	76	13	.93632	77	12	.94851	1.01301
<i>Abnormal Group: General Paralysis (Four Subjects)</i>							
1 (4)	21	3		21	3		
2 (4)	16	8		22	2		
3 (4)	18	6		18	6		
4 (4)	21	3		18	6		
5 (4)	22	2		19	5		
Totals	98	22	.89035	98	22	.89035	1.00000
<i>Abnormal Group: Korsakow Case (One Subject)</i>							
1 (1)	6	0		0	6		
2 (1)	6	0		0	6		
3 (1)	6	0		0	6		
Totals	18	0	1.45312	0	18	.001816	.02039
<i>Abnormal Group: Postencephalitic Case (One Subject)</i>							
1 (1)	6	0		5	1		
2 (1)	6	0		6	0		
3 (1)	6	0		6	0		
Totals	18	0	1.45312	17	1	.912670	.62807

After fifteen repetitions a period of free recall was given. Then a new set of six pairs was mixed with the old. At the recognition test both members of the pairs were tested. The first members were shown first and then the series of the old and new were run through again in the same order testing out the second members of the pairs.

Table XXV gives the results for free recall and also for recall of associates. The normals showed a very high percentage of recall for both members of the pairs in free recall and an equally high percentage of recall of associate. The seniles recalled only

TABLE XXIV-A

RELATION OF RECOGNITION AND RECALL IMMEDIATELY AFTER
TEN REPETITIONS: SERIES V, TESTS 1-5.

Type of Case	Total Number of Tests	Free Recall of First Member	Free Recall of Second Member
Normal	156	94.2%	92.3%
Abnormal			
Seniles	96	2.1%	5.2%
Pre-Seniles	90	46.0%	43.8%
Gen. Paralysis	120	25.0%	30.0%
Post-Enceph.	18	27.7%	38.8%
Korsakow case	18	5.5%	5.5%

TABLE XXIV-B

Type of Case	Total Number of Tests	Second Member Shown and Correctly Recognized	First Member Recalled as Associate when Second Member Shown and Recognized
Normal	156	91.6%	97.4%
Abnormal			
Seniles	96	00.0%	27.1%
Pre-Seniles	90	19.1%	80.8%
Gen. Paralysis	120	15.8%	82.5%
Post-Enceph.	18	00.0%	100.0%
Korsakow case	18	00.0%	100.0%

approximately 5 per cent of each member freely and no associates. The Korsakow case recalled none of the first and 11.1 per cent of the second member in free recall but no associates. The pre-seniles gave about 48 per cent of each member in free recall but only about 25 per cent of the associates for each. The general paretics gave about 34 per cent of both members and 33 per cent of the associates. The post-encephalitic gave 28 per cent free recall for the first member with 44 per cent for the second member. In giving the associates she gave 11 per cent of those for the first member and 22 per cent of those for the second member.

TABLE XXV
RECALL AFTER THE FIFTEENTH REPETITION.

Test Series Number	Number Tested	Free Recall First Member	Free Recall Second Member	Associate Recalled	
				First Member when Second Shown	Second Member when First Shown
Normal Subjects					
1	4	21	23	21	23
2	4	24	24	24	24
3	5	30	30	29	30
4	6	35	34	36	34
5	7	41	41	42	40
Totals		151	152	152	150
Percentages		96.7	97.4	97.4	96.1
Senile Subjects					
1	3	1	2	0	0
2	3	0	1	0	0
3	3	0	0	0	0
4	3	2	2	0	0
5	3	1	0	0	0
Totals		4	5	0	0
Percentages		4.4	5.5		
Pre-Senile Subjects					
1	3	13	13	0	0
2	3	10	9	5	9
3	3	4	6	4	2
4	3	9	10	9	8
5	3	7	6	4	5
Totals		43	44	22	24
Percentages		47.7	48.8	24.4	26.6
General Paralysis Cases					
1	4	7	5	9	6
2	4	12	13	13	11
3	4	6	6	5	10
4	4	7	7	6	9
5	4	11	8	8	3
Totals		43	39	41	39
Percentages		35.8	32.5	34.1	32.5
Korsakow Case					
1	1	0	0	0	0
2	1	0	2	0	0
3	1	0	0	0	0
Totals		0	2	0	0
Percentages		0	11.1		
Post-Encephalitis Case					
1	1	2	2	1	1
2	1	1	4	0	3
3	1	2	2	1	0
Totals		5	8	2	4
Percentages		27.7	44.4	11.1	22.2

Table XXVI shows the order of frequency of the words given in the free recall period after fifteen repetitions. The totals are for the five tests of the series.

TABLE XXVI

Type of Case	First Members of Pairs						Second Members of Pairs					
	1st	2nd	3rd	4th	5th	6th Pairs	1st	2nd	3rd	4th	5th	6th Pairs
Normal Group....	25	25	26	25	24	26	26	25	26	25	24	26
Senile Group.....	0	0	0	0	1	3	0	0	0	0	1	4
Pre-Senile Group..	7	6	6	5	9	10	7	6	5	7	8	11
G. P. Group.....	8	7	8	4	8	8	7	6	8	6	6	6
Korsakow Case....	0	0	0	0	0	0	0	0	1	0	0	1
Post-Enceph. Case	0	0	1	2	0	2	0	0	1	2	3	2

Here it will be noted that the normals recalled all members about equally. The seniles recalled only the last two pairs in the series. The preseniles recalled some of all pairs but did better with the last two pairs. The general paretics did about the same for all pairs except the first member of the fourth pair which was much lower. The second member scores were slightly lower than those for the first members. The Korsakow case remembered only two, the second members of the third and sixth pairs. The post-encephalitic case recalled neither members of the first and second pairs nor the first member of the fifth pair, but remembered about equally the other pairs.

Series VI. Learning of Nonsense Syllables

The results of the normal subjects in mastering a series of fourteen nonsense syllables are given in the table below.

TABLE XXVII

ANALYSIS OF RESPONSES: PROMPTING METHOD: NORMAL GROUP.

Test Number	Number Individuals	Repetitions Required	Time in Minutes	Responses			
				Correct	Omitted	Wrong	Totals
1	5	49	113	385	148	153	686
2	6	58	131	474	157	181	812
3	7	39	107	302	146	98	546
4	7	37	94	340	85	93	518
5	7	31	67	315	40	79	434
6	6	52	123.5	428	113	187	728
7	6	38	94.5	283	116	133	532
8	6	43	114	366	79	157	602
9	5	27	58	253	48	77	378
10	5	31	23	276	68	90	434
Totals		405	925	3422	1000	1248	5670
Average		6.7	15.4				
Range		(1-19)	(3.5-35)				
Percentages				60.4	17.6	22.0	

Here it is seen that the average number of repetitions required is 6.7 with an average time of fifteen minutes. Sixty and four-tenths per cent of the responses were correct. The other responses were of two types, negations and errors. These correspond to W. G. Smith's forgetting and confusion errors. Forty-five per cent of the other responses or 18 per cent of all responses were negations.

The results with the abnormal subjects in the learning series by the prompting method are given in the following table:

TABLE XXVIII
ANALYSIS OF RESPONSES: PROMPTING METHOD: ABNORMAL GROUP.

Test Number	Number Individuals	Repetitions Required	Time in Minutes	Responses			Totals
				Correct	Omitted	Wrong	
Schizophrenia Cases (Four Subjects)							
1	4	56	64(1)	407	219	158	784
2	4	47	136	295	184	179	658
3	4	26	72	200	77	87	364
4	3	24	62	203	53	80	336
5	3	29	43(2)	267	51	88	406
Totals		182	377	1372	584	592	2548
Average		10.1	26				
Range		(4-27)	(16-64)				
Percentages				53.8	22.9	23.2	
Psychoneurosis (One Subject)							
1	1	32		201	79	168	448
2	1	14	24	117	40	39	196
3	1	24	43	202	62	72	336
4	1	17		155	36	47	238
5	1	8	14	83	11	18	112
Totals		95	81(3)	758	228	344	1330
Average		19	27				
Range		(8-32)	(14-43)				
Percentages				56.9	17.1	25.8	
Manic-Depressive: Depressed Phase (Two Subjects)							
1	1	17		125	53	60	238
2	1	19		144	73	49	266
3	1	20		149	88	43	280
6	1	8	22.5	76	7	29	112
7	1	6	25	44	18	22	84
8	1	5	23	33	10	27	70
9	1	3	16	28	1	13	42
10	1	5	15	50	2	18	70
Totals		83	101.5	649	252	261	1162
Average		10.3	20.3				
Range		(3-20)	(15-25)				
Percentages				55.8	21.6	22.4	

TABLE XXVIII (Continued)

Test Number	Number Individuals	Repetitions Required	Time in Minutes	Responses			
				Correct	Omitted	Wrong	Totals
<i>Manic-Depressive: Manic State</i>							
1	1	8	38	54	26	32	112
2	1	6	24	42	23	19	84
3	1	9	32	69	20	37	126
4	1	8		63	22	27	112
5	1	12	25	116	17	35	168
Totals		43	119	344	108	150	602
Average		8.6	29.7				
Range		(6-12)	(25-38)				
Percentages				57.1	17.9	24.9	
<i>Psychopathic Personality (Two Subjects)</i>							
6	2	25	14(1)	220	30	100	350
7	2	18	42	147	42	71	252
8	2	13	15(1)	117	11	54	182
9	2	11	34	92	17	45	154
10	1	5	17(1)	43	7	20	70
Totals		72	122	619	107	290	1008
Average		8	17.4				
Range		(5-25)	(12-42)				
Percentages				61.4	10.6	28.7	

The average number of repetitions required for the psychopaths was 8 with an average time of 17.4 minutes. The manic depressive, manic state, required an average of 8.6 repetitions with an average time of 29.7 minutes. The schizophrenics required an average of 10.1 repetitions with an average of 26 minutes. The manic depressive, depressed cases, needed an average of 10.3 repetitions with an average time of 20.3 minutes. The psychoneurotic required an average of 19 repetitions with an average time of 27 minutes. She required more time and repetitions than the other abnormal subjects except C.H., a manic depressive, depressed phase, whose results were not included. This patient showed a very great amount of distractibility. She required six sittings for the mastery of the first series with 82 repetitions. She had 58.4 per cent of her responses correct. With the next series she required five sittings and 60 repetitions. Here she made 55.9 per cent correct responses. In the third series she succeeded with the series in four sittings and 43 repetitions so it could be noted that she benefited from practice. Here her percentage of correct responses was 46.5 per cent.

The normal individuals did better than the abnormals with a range of 1 to 19 repetitions and 3.5 to 35 minutes, while the abnormals ranged from 3 to 32 repetitions and from 12 to 64 minutes.

The errors were analyzed as to type in the succeeding tables. A word is necessary in regard to the terms used to describe the types of errors made. By an "anticipatory" error is meant naming a word prior to the place where it rightfully belongs in the series. By "hold-over" is meant the giving of a word after its place in the series has been passed. By "partial" is meant a word which has two of the three letters correct. By "incomplete" is meant the giving of one or two letters only. "Partial and incomplete" is used for those cases where two letters are given and given correctly. "Partial and anticipatory" and "partial and hold-over" cover those cases where two of three letters are correct but the position is not, in the former case coming before the right place and in the latter following it. "Reversal" is used for those cases where the letters given are correct but in reverse order, as *zew* given as *wez*. "Confusion—this series" takes in those errors where two syllables of the same series are mixed and one given in the place of the other. "Confusion—other series" refers to those errors where a syllable of the study series is confused with a syllable of one of the other series or is omitted to give way to a place association from a former series or a syllable from another series comes in but not in its place association. "Extraneous" is the term given those errors called errors of insertion by Smith; letters in no way connected with the study series or any of the series previously studied are included under this heading. By far the greater proportion of the errors made, both with the normal and the abnormal subjects, were those of the anticipatory kind.

Fifty-five per cent of the errors, therefore, were of the anticipatory type; 16.9 per cent were of the partial type. Considering the two forms of confusion errors there were 3.1 per cent of this kind. Four per cent of the errors were due to the insertion of extraneous material.

TABLE XXIX
 SERIES VI: ANALYSIS OF ERRORS.
Normal Subjects

Test Series	Number Indiv. Taking Test	Total Responses	Types of Errors Made									Confusion		Extran.	P. & R.	Rev.
			Anticip.	Partial	A & P.	A. P. I.	Inc.	P. & I.	H. & I.	Holdover	P. & H.	Same Series	Other Series			
1	5	153	86	12	8		7			26	7			5		2
2	6	181	72	29	25	1	8	3		13	4	9	8	9		
3	7	98	40	21	7		8	3		3	2	3	2	9		
4	7	93	55	22	1		4	1	1	2		3	3	1		
5	7	79	32	21	9		4	3		5	2		1	1		1
6	6	187	89	13	32		14	1		17	1			19		1
7	6	133	60	19	14		4	2		18	5	1		3	5	1
8	6	157	77	35	22		1	3		9	3		2	2	2	1
9	5	77	40	19	6		3			4	1		1	1		2
10	5	90	39	21	9		8	2		3	1		6	1		
Totals		1248	690	212	133	1	61	18	1	100	26	16	23	51	7	8

In the following table the errors made by the abnormal types are arranged under the same classification as with the normal group earlier.

TABLE XXX

Test Series	No. of Indiv.	Total Responses	Types of Errors Made						Confusion		Extran.	H. & P.	Rev.
			Antic.	Partial	A. & P.	P. & I.	Inc.	Holdover	Same Series	Other Series			
Schizophrenia													
1	4	158	112	8	7		5	16	1		2	1	
2	4	179	81	27	27	4	5	22		8	3	1	
3	4	87	42	14	15		9	2	2	2	1		
4	3	80	61	9	2		1	6			1		
5	3	88	48	15	3		8	12		2			
Totals		592	344	73	54	4	28	58	3	12	7	2	
Psychoneurosis													
1	1	168	112	2	6		2	44	3		1		
2	1	39	25	7				6	1				
3	1	72	55	1	6			10					
4	1	47	40	4	2				1				
5	1	18	16	2									
Totals		344	246	16	14		2	60	5		1		

TABLE XXX (Continued)

Test Series	No. of Indiv.	Total Responses	Types of Errors Made						Confusion		Extran.	H. & P.	Rev.
			Antic.	Partial	A. & P.	P. & I.	Inc.	Hollover	Same Series	Other Series			
Manic-Depressive: Manic Phase													
1	1	60	47	4	4			4					1
2	1	49	26	5	9			7			1		1
3	1	43	37					1	4			1	
6	1	29	25	1				2					
7	1	22	18				2	2					
8	1	27	15	2	1		1	1		5			
9	1	13	10				1				2		
10	1	18	12	3	2					1			
Totals		361	190	15	16		5	17	4	6	3	1	2
Manic-Depressive: Manic State													
1	1	32	20	4			2	3	2				1
2	1	19	9	3	3	1		2	1				
3	1	37	16	5				8	5		1	1	1
4	1	27	19	2			1	4		1			
5	1	35	29	1	2		1	2					
Totals		150	93	15	5	1	4	19	8	1	1	1	2
Psychopathic Personality													
1	2	100	65	11	16			3			3		
2	2	71	58	1			3	4			5		
3	2	54	30	4	3		6	3		7	1		
4	2	45	33	3				7			2		
5	1	20	16	2	1					1			
Totals		290	202	21	20		9	17		8	11		

An analysis of the order of appearance in the mastery of members of a series of nonsense syllables of the various members was made. The word that appeared first correctly was given the rank of 1, and the second the next and so on for the 14 members of the series. Totals of the individual ranks were found and the results ranked a second time. Table XXXI shows the results on this test.

TABLE XXXI
ORDER OF APPEARANCE IN LEARNING BY THE PROMPTING METHOD

<i>Normal Subjects</i>														
Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	2	1	12	10	4	5	11	3	9	8	14	13	7	6
II	1	4	2	3	14	9	11	8	5	7	13	6	12	10
III	3.5	1	3.5	5	12	7	2	8.5	14	8.5	11	13	6	10
IV	1.5	1.5	3	7	12	5.5	8	14	13	10	4	5.5	10	10
V	4.5	1.5	1.5	3	7	11	13	8	9	4.5	7	12	14	10
Totals	12.5	9	22	28	48	37.5	45	41.5	50	38	49	49.5	49	46
Ranks	2	1	3	4	10	5	8	7	14	6	11.5	13	11.5	9

TABLE XXXI (Continued)

Abnormal Subjects: Non-Deteriorated Type

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	1	3	10	2	6	4	12	14	5	11	7.5	9	13	7.5
II	1	2	4	3	8	7	13	12	14	10	11	6	9	5
III	2.5	1	2.5	4	6	5	8	13	11	12	14	10	9	7
IV	3	1	5	4	10	8	7	14	6	12	13	9	11	2
V	1	2	4	5.5	3	13	10	12	9	8	7	11	14	5.5
Totals	8.5	9	25.5	18.5	33	37	50	65	45	53	52.5	45	56	27
Ranks	1	2	4	3	6	7	10	14	8.5	12	11	8.5	13	5

V. SUMMARY AND CONCLUSIONS

1. Experimental psychology should include within the scope of its experimentation work with abnormal mental cases both for the knowledge of these types obtainable in this way and for the light thrown on normal mental processes.

2. Experimental work with abnormal types offers greater difficulties than work with normal subjects. Some of the difficulties are due to distractibility, inaccessibility, marked fluctuation of mood, emotional disturbances, reticence, dislike of routine and repetition, reaction to sameness of material and its lack of meaning, lack of persistence, suspicion of any experimentation. However, with simple apparatus and technique usable results can be obtained.

3. The comments made by the patients at the time of the test in regard to how they recognized the symbol or syllable before them did not show evidence of retrospection but rather an assigning of cues used in the recognition. A large number passed judgment without being able to give any reason for their procedure. This was also true in the case of the normal subjects untrained in introspective report. There were no outstanding differences characteristic of the responses of the abnormal. The reports had many comments, however, that gave information about the patient's thought content. A.St., a manic patient, complained on one of the experimental days (7-19-27) of a "vapory feeling," a "blurring" which came between her and the symbol or word to be reported upon. This made it very hard to pass judgment upon the series. Her explanation was, "There is some power over me aggravating and annoying me by turning the haze off and on." She then went into detail about how this was accomplished by means of electricity. The reports of both abnormal and the normal untrained subjects were not very long or detailed.

4. In the recognition test the use of probability scores for the two types of material with the ratio between the two gives an

idea of the striking difference between the success with the old and the new material among the various types of subjects. It offers a very good means of comparison since a norm is set up for the normal group which is the basis of the contrast between this normal group and the abnormal ones. By this means in the recognition problems it was determined for the non-deteriorated mental cases with meaningful material that the psychoneurotic differed least from the normal while the manic depressive, depressed phase, differed most with the schizophrenic in between.

With the partially meaningful material when the Chinese member was shown the two non-deteriorated groups tested showed the manic state most like the normal and the schizophrenic differing noticeably while with the English equivalent the opposite was true, the schizophrenic being closer to the normal.

With the nonsense material for the twenty-minute interval for both the Chinese symbols and Romanized equivalents the schizophrenic was most like the normal and the manic state least like. For the one-hour interval all groups differed decidedly from the normal, the psychoneurotic and psychopaths most, and then the manics to a less degree and the schizophrenics to a lesser degree than the others. For the twenty-four hour interval the schizophrenic was most like the normal, the psychoneurotic least like the normal with the others between. Of these the psychopath was least like the normal, the manic depressed phase and manic state slightly better than the psychopath.

For the deteriorated case with recognition of meaningful material the seniles and Korsakows differed most, then the pre-seniles, then the post-encephalitic case with the general paretic somewhat closer to the normal. For nonsense material the senile and Korsakow were least like the normal, then the post-encephalitic and preseniles and again the general paretics were closer to the normal.

5. Normal individuals show very great success in the recall and recognition of meaningful material. This same success was achieved by the three schizophrenia subjects and by the psychoneurotic one. The seniles and the Korsakow case failed to a very marked degree. From their reactions on the picture test as

well as the tests with nonsense material it seems that there is a complete disintegration of the central organization of their mental processes. In the normal individual there is built up through associations and habit, systems of likenesses and differences with the appreciation of order and plan as the highest type of central organization (cf. Shepard (28)). In the senile the ability to plan is entirely gone as well as the ability to hold things in an orderly arrangement. Likenesses and differences are not appreciated. Forming new associations appears an impossible task. The grasping of new impressions or the derivation of meaning from them is also out of the question. Some of the very early past habits of the simplest kinds are left. The subjects had not forgotten how to read; they knew their names and facts about their history but beyond this there was no evidence of retention. The manic depressive, depressed phase cases, did not make high scores. Here it was clear from the comments of the patients that the pictures of the series were remembered to some extent but the portions shown were rejected as not belonging because they were viewed from a new angle. P.A. saw the portion of the marsh in the picture of the ducks as a forest and the windows in the Dutch scene as doors, so both were classed as new. However, when the sorting test was given these patients were entirely successful. The general paralysis cases and the presenile cases scored about the same, in both cases there was evidence of deterioration. While they succeeded to some extent in recognizing and recalling there seems to be difficulty in gaining meaning from new impressions and in making associations.

6. With Chinese symbols and their English equivalents one group of schizophrenic cases showed a decided change from the normal in that where the ratio of new to old for the normal was 1.48 with these cases it was 16.18. The new material did not cause confusion but the old did. One of these patients, J.K., showed a distinct bias on occasions some days for calling everything new and on other days for calling everything old. The judging of everything as new was the more frequent response. Her responses were so meager that nothing could be gained as a clue to her reasons in any of the cases.

In two other cases of schizophrenia where more judgments were obtained there was no marked difference from the normal.

When Chinese symbols were used with English equivalents it seemed to be easier to connect up the symbol and the word. It was found practically impossible to do this with the Chinese and Romanized material.

Free recall was not given but for the recall of associates the normals showed with the Chinese a 7.6 per cent correct recall and with the English 9/10 of 1 per cent correct recall. The schizophrenics showed a 7 per cent correct recall with the Chinese and no correct recall of the English. The manic depressives, manic state, gave no correct recall.

7. The increase of the interval of test decreased the recognition efficiency with both normals and abnormals. It also decreased the recall.

8. The learning test with the deteriorated cases showed that both the seniles and the Korsakow case had lost their ability to learn. The responses given can be viewed in the light of the memory span which was one or two but rarely more that could be remembered immediately afterwards. The last two words in the series were favored. This same tendency was noted in the presenile cases but here the memory span was longer. In some cases there was a mastery of the series. The neglect of the Chinese symbols by the deteriorated cases showed that they were entirely meaningless to them and that they knew of no way to deal with them. On the other hand they reacted differently to the words because although they were nonsense they had had past experience with letters and could spell them out. This test showed that the three groups, normal, senile and presenile occupied vastly different positions in their success with this type of material. The normal and the senile being at opposite extremes with the presenile between but approaching to the senile level.

9. With the paired nonsense material the Korsakow case and senile showed the same results in regard to recall, neither could give many in the free recall period and they could give no associates. In recognition, however, they differed decidedly. The Korsakow case gave all the old as old but she also gave all the

new as old. The senile cases, on the other hand, gave the old as new and the new were given to a great extent as new. In Smith's terms the Korsakow case made confusion errors while the seniles' errors were those he designated forgetting.

10. Since learning is dependent on the ability to associate we find the seniles and Korsakow case, who were unable to form any associations, failing. The other deteriorated cases had some success but far from that of the normal. The non-deteriorated cases succeeded but there were great individual differences.

11. Recall and recognition are parts of the same fitting-in process, both dependent upon perception and association. They differ in that mere belonging together is sufficient in recognition. For recall more is needed. In recognition the association is subliminal. In recall it is not.

12. In the process of deterioration recognition tends to disappear for those cases where new impressions can no longer be grasped. In these cases too if there is any recall it is of small span and brief duration.

VI. APPENDIX A

TEST SERIES AND DIRECTIONS

SERIES I: PICTURES

The first eight in the list are the ones used in the study period, the last seven are the ones added at the test period. The portion of the picture used in the test is described under each picture.

- No. 1. Portrait of child standing by a jewel case playing with beads.
Artist: C. Max. Size of picture—Length, $8\frac{7}{8}$ inches; width, $6\frac{3}{4}$ inches.
Portion shown in test: Child's hand and part of the string of beads.
- No. 2. Kinderbildnis (portrait of a child in a red dress).
Artist: Hela Peters. Size of picture—Length, $9\frac{3}{8}$ inches; width, $7\frac{1}{8}$ inches.
Portion shown in test: Basket with a green ball in it (at child's left in the picture).
- No. 3. Picture of a boy lying on the grass piping to some ducks.
Artist: H. Clements. Size of picture—Length, 7 inches; width, 9 inches.
Portion shown in test: Several ducks including one that appears to be definitely looking toward the boy.
- No. 4. Fisherman's Children (No. 3587, Meister der Farbe series: E. A. Seaman, Leipzig, Germany).
Artist: Wm. Pratt. Size of picture—Length, $9\frac{3}{4}$ inches; width, $7\frac{1}{4}$ inches.
Portion shown in test: Small sail boat of boy; feet of older girl.
- No. 5. Ducks (No. 3723, Meister der Farbe series: E. A. Seaman).
Artist: Alexander Köster. Size of picture: Length, $7\frac{1}{2}$ inches; width, 9 inches.
Portion shown in the test: Grassy section with clump of weeds.
- No. 6. Polar bear family (No. 2028, Hundert Meister der Gegenwart series: E. A. Seaman).
Artist: Richard Friese. Size of picture—Length, 6 inches; width, $9\frac{3}{8}$ inches.
Portion shown in the test: Stretch of snow.
- No. 7. Rote Dächer (No. 3119, Meister der Farbe series: E. A. Seaman).
Artist: F. Thaulow. Size of picture—Length, $8\frac{3}{4}$ inches; width, $7\frac{1}{8}$ inches.
Portion shown in the test: Cobblestones of street, side of house.
- No. 8. Dutch Interior (No. 1256, Die Galerien Europas series: E. A. Seaman).
Artist: Peter de Hooch. Size of picture—Length, $8\frac{3}{4}$ inches; width, $7\frac{1}{4}$ inches.
Portion shown in the test: Section of leaded glass upper windows.
- a. Portrait of a boy standing with a whip in his hand.
Artist: C. Max. Size of picture—Length, 9 inches; width, 7 inches.
Portion shown in the test: The boy's hand with part of the whip.

- b. Blondchen (No. 3839, Meister der Farbe series: E. A. Seaman).
Artist: L. V. Zumbusch. Size of picture—Length, $7\frac{7}{8}$ inches; width, $7\frac{7}{8}$ inches.
Portion shown in test: Part of tree in background.
- c. Frühlingstag (No. 3096, Meister der Farbe series: E. A. Seaman).
Artist: Franz Slaby. Size of picture—Length, 7 inches; width, $7\frac{5}{8}$ inches.
Portion shown in the test: Ducks, lower portion of girl, roadway.
- d. Abend in der Mark (No. 3914, Meister der Farbe series: E. A. Seaman).
Artist: Julie Wolfthorn. Size of picture—Length, $7\frac{3}{8}$ inches; width, $9\frac{1}{4}$ inches.
Portion shown in the test: Part of river, tree, top of boy's head.
- e. Polar region (No. 2060, Hundert Meister der Gegenwart: E. A. Seaman).
Artist: H. Urban. Size of picture—Length, $6\frac{3}{4}$ inches; width, $9\frac{3}{8}$ inches.
Portion shown in the test: Stretch of snow and dark rocks.
- f. Die Bergkirche (No. 3213, Meister der Farbe series: E. A. Seaman).
Artist: W. Wirkner. Size of picture—Length, 7 inches; width, $8\frac{3}{8}$ inches.
Portion shown in the test: Part of the lower portion of the church, grass.
- g. The Rector's Study.
Artist: Not known. Size of picture—Length, $6\frac{7}{8}$ inches; width, $8\frac{7}{8}$ inches.
Portion shown in the test: Part of upper portion of room showing beams in roof, window and doorway.

DIRECTIONS GIVEN THE SUBJECTS ORALLY FOR SERIES I

SERIES I: PICTURE TEST

Instructions

For the observation period:

"You will be shown a picture for study. Observe it very carefully, be ready to suggest a suitable title for the picture and to give as many of the details as possible. Ready now. Begin."

For free recall:

"Write the list of pictures you have been shown for study." With the deteriorated cases this was changed to, "Tell me all the pictures you have been shown for study." The experimenter then wrote out the list given.

For sorting:

"Take these pictures and put them into two piles; the ones that you have seen, the old ones, and the ones that you have not seen, the new ones."

For order:

"Here are the pictures you have been shown. Arrange them in the order they were shown you for study, the first one you studied should be first, the second next and so on for the whole group."

For similarity:

"Some of the new pictures are similar in some way to the old. Select new ones that you think have something in common with the old and be ready to tell the reason for your selection."

The order of test arrangement for the pictures was as follows:

Nos. 4-2-e-a-f-1-6-b-5-8-g-7-c-3-d.

SERIES II: CHINESE SYMBOLS PAIRED WITH ENGLISH EQUIVALENTS

The first member was the English equivalent, the second member of the pair the Chinese symbol. The numbers 1 to 14 represent the pairs in the learning series. The letters a to f represent the new pairs added at the test period. Series A was a preliminary test series.

II-A	II-1	II-2	II-3	II-4	II-5
1 repair	principle	sour	flat	yesterday	ocean
2 plow	not sensible	clear	horse	miseries	section
3 rain	rise	village	rice	hair	edge
4 report	success	slow	kind of tree	knock	postal
5 ought	beginning	smoke	you	jump	principal
6 hail	pull up	odor	hamlet	tooth	decree
7 rice	blossom	praise	buy	talk	honesty
8 white	year	hall	shut	crystal	create
9 sprouts	commerce	wait	arise	boy	little
10 connect	gospel	equal	full	run	unreasonable
11 pass	conversation	bridge	position	road	advice
12 lift	pity	avoid	close	regret	remove
13 agree	curved	encourage	certificate	delegate	chase
14 enter	west	soldier	thrive	wish	hear
a help	face	stupid	misfortunes	word	stranger
b print	world	careful	signboard	obstruction	deep
c respect	insect	south	select	present	secure
d effective	depart	wife	busy	mineral	biography
e end	command	swell	capitol	naught	man
f prevent	insist	investigate	to get	type	deviate

DIRECTIONS GIVEN ORALLY FOR SERIES II

Instructions

"This is a test of recognition. You will be shown for study a series of Chinese symbols with their English equivalents or meanings opposite them. The English will be shown here (indicating left hand side of exposure space) and the Chinese here (indicating right hand side). Read the letters to yourself, look carefully at the symbol but do not try to force associations. You are not to think of them between the time of showing and the test. After twenty minutes you will be shown some of the old ones mixed with some new ones. Part of the time you will be shown only the Chinese symbol and part of the time just the English word. You will be asked to tell whether you have seen before what is being shown, in which case you say 'old' or whether you have not seen it before, in which case you say 'new.' If it is an old one you are to tell if possible what went with it. Do you understand? Ready. Watch this opening. Remember to study carefully both members of the pair."

The order of test arrangement for Series II was as follows for each of the six series where A was the preliminary series.

Order of test:

- A. 12-7-a-5-b-9-1-3-e-13-11-f-10-c-8-6-d-4-2-14
 1. 7-f-2-13-9-a-11-c-1-10-d-3-e-8-4-12-b-5-14-6
 2. 8-4-c-6-9-2-a-e-11-1-3-f-5-7-10-14-b-13-d-12
 3. 6-2-9-f-4-13-a-12-b-7-10-c-5-1-3-8-d-11-3-14
 4. d-6-1-14-a-3-9-13-4-b-10-2-5-f-7-c-12-e-8-11
 5. 14-7-d-f-2-b-8-6-13-1-a-4-12-c-3-5-11-9-e-10

SERIES III: CHINESE SYMBOLS PAIRED WITH ROMANIZED SYLLABLES

The first member of each pair was a Chinese symbol. The second members of the series are given below. Series A and B were preliminary series. The numbers 1 to 14 represent the pairs in the learning series. The letters a to f represent the new pairs added at the test period.

III-A	III-1	III-2	III-3	III-4	III-5
1 tuan	chia	chüan	hsiao	tsan	fu
2 ling	hsüan	lin	yin	ting	ch'ih
3 hsin	(blank)	ch'a	chung	fang	(blank)
4 liang	ho	(blank)	tien	pu	jou
5 pao	chien	pan	(blank)	(blank)	hung
6 p'o	ti	t'iao	ya	shi	tao
7 yao	(blank)	ch'i	(blank)	tou	(blank)
8 wu	ti'en	liu	lu	(blank)	wei
9 k'e	fan	(blank)	chi	cha	shu
10 shen	(blank)	jen	jih	min	(blank)
11 chiao	ch'un	ch'u	hsi	hsing	tsui
12 chieh	hsiang	(blank)	(blank)	kuo	ti'eng
13 ch'uan	(blank)	pei	kuan	wai	(blank)
14 chang	yü	(blank)	ching	(blank)	yung
a mou	I	chiang	chuan	huan	(blank)
b tung	(blank)	k'ai	hsia	(blank)	chiu
c pin	hui	tsu	(blank)	c'hu	E
d chih	k'ou	(blank)	tzu	(blank)	erh
e shih	(blank)	shou	ch'ang	pai	(blank)
f shuo	(blank)	hsüeh	fa	hua	ts'ao
III-B	III-6	III-7	III-8	III-9	III-10
1 (blank)	shao	komi	do	chuai	hsu
2 k'ang	(blank)	(blank)	ei	ang	huai
3 hu	ch'ing	lan	feng	(blank)	peng
4 (blank)	k'un	mi	(blank)	pa	(blank)
5 mien	(blank)	(blank)	fi	shuan	wang
6 tsung	kung	nai	yun	tsang	niu
7 (blank)	hsün	jang	(blank)	(blank)	(blank)
8 shun	huo	hanashi	wha	wua	je
9 fei	(blank)	fon	quen	ta	king
10 ch'eng	keng	goh	sha	(blank)	shan
11 (blank)	yan	ai	pou	siao	nei
12 chin	mao	chu'eh	jao	han	mei
13 che	(blank)	meng	(blank)	hsian	(blank)
14 tang	hao	(blank)	lun	tso	lou
a chou	fong	(blank)	en	er	(blank)
b ming	(blank)	k'o	yiü	whai	teng
c (blank)	tieh	t'ao	(blank)	yeh	men
d kan	ch'ou	(blank)	(blank)	(blank)	ou
e hei	an	tse	tu	(blank)	sui
f kuei	li	k'ang	mang	fen	ning

DIRECTIONS GIVEN ORALLY FOR SERIES III

Instructions

"This is a test of recognition. You will be shown for study a series of Chinese symbols with letters opposite them, which to the Chinese give the clue for pronunciation and which have no meaning for us. Occasionally there will be a symbol without letters opposite it. The Chinese symbol will be shown here (indicating left hand side of exposure space) and the letters or Romanized syllables here (indicating right). After twenty minutes, one hour, or twenty-four hours (according to the time interval of the test) you will be shown some of the old ones mixed with some new ones. Some of the time this part (indicating the first shutter) will be open showing the Chinese symbol and some of the time this (indicating second shutter) will be open showing the Romanized syllables. At that time you are to report (1) whether you have seen before what is presented, in which case you say 'old,' or whether you have never seen it, in which case you say 'new.' If it is an old one you are to tell if possible what went with it. Do you understand? Ready. Watch this opening. Remember to study carefully both members of the pair. You are not to think of them between the time of showing and of the test."

The order of test arrangement for Series III was as follows:

Order of test:

A and B 12-7-a-5-b-9-1-3-e-13-11-f-10-c-8-6-d-4-2-14
 1 and 6 7-f-2-13-9-a-11-c-1-10-d-3-e-8-4-12-b-5-14-6
 2 and 7 8-4-c-6-9-2-a-e-11-1-3-f-5-7-10-14-b-13-d-12
 3 and 8 6-2-9-f-4-13-a-12-b-7-10-c-5-1-3-8-d-11-e-14
 4 and 9 d-6-1-14-a-3-9-13-4-b-10-2-5-f-7-c-12-e-8-11
 5 and 10 14-7-d-f-2-b-8-6-13-1-a-4-12-c-3-5-11-9-e-10

SERIES IV: CHINESE SYMBOLS PAIRED WITH NONSENSE SYLLABLES

The numbers 1 to 6 indicate the pairs used in the study series, the letters a to f the pairs added for the test series. The Chinese symbol was at the subject's left, *i.e.*, was the first member of the pair. The nonsense syllables paired with them are given in the following lists. Series A was a preliminary test series.

IV-A	IV-1	IV-2	IV-3	IV-4	IV-5
1 cem	kod	jas	nug	kur	fam
2 tic	med	rup	hab	lol	rek
3 cet	vif	dau	gud	nim	jid
4 ron	del	lum	bax	zak	gen
5 mer	bap	zan	bef	lut	dup
6 pud	sof	zef	var	zed	hex
a sed	zik	sut	dit	zeh	nus
b pam	hup	laj	rul	bec	rel
c zob	goz	woj	yog	nak	mac
d rad	miz	rix	tur	buj	ber
e tol	woy	viv	yim	sel	dem
f duf	dut	mor	maz	cil	lin

DIRECTIONS GIVEN ORALLY FOR SERIES IV

Instructions

"You will be shown a series of Chinese symbols with letters opposite them. You are to look carefully at the symbol and spell aloud the letters of the word. As soon as you have finished the series you are to tell me all the words that you remember. See if you can remember them all."

At the end of the third repetition after the subject had reported, the following was given, "You will be shown some new symbols and letters with some old ones. As soon as you decide whether a symbol and its letter are (1) new, i.e., you have never seen them before, (2) or old, you have seen them before, let me know."

The order of arrangement of the test series was a chance one but was kept the same for any one series.

Order of test:

- A e-2-1-a-3-6-c-5-f-b-4-d
 1 1-a-5-3-b-6-c-d-2-e-4-f
 2 As of A
 3 As of 1
 4 3-6-c-5-f-b-4-d-e-2-1-a
 5 f-4-e-2-d-c-6-b-3-5-a-1

SERIES V: PAIRED NONSENSE SYLLABLES

In the series given below the syllables marked * were not given with those normal individuals who had had them in other series. The syllables starred at the bottom of each series indicate the syllables put in. Series A was a practice series.

	V-A	V-1	V-2	V-3	V-4	V-5
1	dak-wej	fex-buw	ced-vok*	wiy-zew	riw-soy	kiz-ged
2	nih-baz	nic-xid	zot-yin*	qaz-yos	tuz-hik	vil-heg
3	zap-muh	wuj-dej	suh-tad	mek-xup	dat-coz	hur-boh
4	bey-vaf	zon-cib	fow-lis*	duv-xom*	boj-neq	tiw-bux
5	job-gik	jez-gok	wir-cac	boc-div*	piy-wex	gan-yor
6	caf-moc*	hed-kaj*	ret-gil	naq-wub	ruk-las	ceh-guk
a	tac-pux	goj-rik	ler-tez	zek-yol*	tor-huw	ven-yos
b	xac-jec	flux-deg*	niy-pev	ciz-mev	zab-qim	mod-kel
c	tey-fub	oir-kav*	jus-yol	kuv-daj	ben-mot	qac-tuh
d	kih-xef	wuv-heb	reg-zub	qom-luh	rac-sim	bov-diw
e	wuz-yox	cit-zut	xix-fug	zey-xoq	det-foc	fah-giy
f	ped-xem*	mup-beb*	vul-kas	bic-fav	kup-qek	bir-kuv
	* caz-moq	* het-kac	* ceb-von	* dur-xow		
	* peh-xen	* fax-def	* zot-yiw	* bot-diz		
		* ois-kav	* sub-tah	* zez-yov		
		* muj-bez	* foz-lis	* cig-mev		

DIRECTIONS GIVEN ORALLY FOR SERIES V

Instructions

Preceding the first, sixth and eleventh showing of the series, the following instructions were given:

"You will be shown a series of letters that have no meaning with letters

opposite them, also with no meaning, five times round for study. You are to spell the letters aloud, once each time the series is repeated, and be ready after the fifth time to tell me as many of the words as you remember."

For the recognition test at the end of the fifth repetition the following directions were given: "You will be shown some of the old letters that you have had together with some new ones. The first part only will be shown here (indicating place on screen). You are to tell whether you have seen it and if so to tell what letters went with it."

For the recognition test at the end of the tenth repetition the procedure was the same as for the end of the fifth except that "the second part" was substituted for "the first part" and the corresponding place indicated on the screen.

At the end of the fifteenth repetition, following free recall, the directions were: "You will be shown the first members of the pairs to recall the second." When all the first members had been shown, "Now you will be shown the second part to recall what came first."

The order of the test arrangement was as follows:

A	f-6-d-2-1-a-3-5-b-c-4-e
1	5-d-4-a-3-c-e-2-b-1-6-f
2	3-a-4-1-b-c-5-d-e-2-f-6
3	3-a-5-b-c-k-4-d-2-6-e-f
4	a-b-2-c-6-d-1-3-e-5-f-4
5	4-a-6-b-c-1-d-3-5-e-2-f

SERIES VI: LEARNING SERIES OF NONSENSE SYLLABLES IN SERIAL ORDER

The lists were as follows:

1	2	3	4	5	6	7	8	9	10
cem	jas	kur	hed	kaj	cer	gil	zeh	lug	cir
tic	rup	lol	mup	beb	rop	wel	maz	tez	cac
cet	dau	nim	boc	div	niz	suh	bec	nny	ler
ron	lum	zak	ced	caf	cey	ret	nak	com	fox
mer	zan	lut	vok	moc	moz	jus	buj	wat	deg
pud	zef	zed	ped	fid	puw	col	sel	huf	woj
kod	nug	fam	tad	xem	nog	fow	cil	pev	rix
med	hab	rek	hof	haf	fac	mac	nus	dod	viv
yif	gud	jid	zek	yol	zel	ber	rel	fug	mor
del	bax	gen	lib	nig	soh	kas	yim	mes	dit
bap	bef	dup	reg	san	buz	dem	zog	gif	rul
sof	var	hex	vul	zub	yin	lin	duv	ter	yog
sed	zob	tol	zik	goz	woy	sut	xom	lav	tur
pam	rad	duf	hup	miy	dut	laj	lig	xix	rof

DIRECTIONS GIVEN ORALLY FOR SERIES VI

Instructions

Instructions when the series were to be mastered at one sitting by the prompting method were as follows:

"This is a test of recall. You will be shown for study a series of syllables without meaning. As you study them spell out the letters to yourself—do not try to force associations. After the first time round you will be asked to tell what comes immediately after the one shown. You will continue until you can give the whole series correctly. Do you understand? Ready, remember to study carefully."

When the series was to be shown at one sitting and tested out twenty-four hours later, the instructions were as follows:

"This is a test of recall. You will be shown for study a series of syllables without meaning. Spell out the letters to yourself. Do not try to force associations. You will be shown the series three times round for study, then there will be an interval of ten minutes during which you will do something else. This will be followed by another showing three times round. Then there will be a second interval concluded by showing the series again for three times. You will be tested out twenty-four hours later. You are not to think of the syllables between the showings or between the last showing and the test. Ready now."

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